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ABSTRACT

This instructor's guide contains the materials required to teach a competency-based introductory course in construction welding to students who have chosen to explore careers in construction. It contains three units: welding materials, welding tools, and applied skills. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities for the instructor, extensions and options, information sheets, student supplements, transparency masters, instructional supplements, assignment sheets, job sheets, practical tests, written tests, and answers to assignment sheets and written tests. Academic skills training is combined with vocational training throughout the instructional materials, and a system of icons has been used to help instructors identify activities into which training in the following basic skill areas has been infused: reading, science, creative thinking/problem solving, writing, oral communication, employability, math, interpersonal skills, and social studies. Most units of instruction are designed for use in more than one lesson or class period of instruction. These materials precede the instructional units: information on basic skills in curriculum, information on measuring student performance gains, and required criteria for a competency-based education program. A basic skills documentation matrix and competency profile are provided. (YLB)

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instructor edition

Introduction to Construction Welding

Developed as a Cooperative Project by
the Associated General Contractors of America
Steve L. Hoech, Chairman, Manpower and Training Committee
and
Curriculum and Instructional Materials Center,
Oklahoma Department of Vocational and Technical Education

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Introduction to Construction Welding

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FOREWORD

In 1985, The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project a course of instruction designed for training individuals who choose to seriously explore careers in construction.

This revised publication is the result of those original discussions and updates made through close coordination among general contractors and vocational educators. This series represents conscious effort to coordinate the practical experience of personnel in the carpentry industry with the best instructional methods of those in the field of vocational education.

Although this book reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in the Introduction to Construction Welding manual should be adapted and modified to coincide with local conditions.

Roy Peters, Jr.
State Director
Oklahoma Department of Vocational
and Technical Education

Steve L. Hoech, Chairman
Manpower and Training Committee
The Associated General Contractors
of America

PREFACE

Construction requires that students have many skills and related information to become productive workers in this challenging field. Workers must be better trained and equipped to find and retain meaningful employment.

Instructional materials in this manual is written in terms of student performance, using measurable behavioral learning process. Criterion-referenced evaluation instrument provide for a uniform measurement of student progress.

The purpose of this manual is to assist instructors in all construction related areas in providing instruction throughout the industry. Any information in this manual that does not concur with the instructor's course of study should be modified to meet personal needs.

Personnel safety is of prime concern, as an instructor you are encouraged to closely observe and couch students in all safety issues. We have done much to advise students of possible dangers, but your close supervision and alertness can't be overemphasized.

Al Willey
Curriculum and Instructional
Materials Center
Oklahoma Department of Vocational
and Technical Education

ACKNOWLEDGEMENTS

Much appreciation is expressed to the many individuals who contributed their time, talents, and knowledge in the revision of this manual.

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USE OF THIS PUBLICATION INSTRUCTIONAL UNIT

Introduction to Construction Welding contains three units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities for the instructor, extensions and options, information sheets, students supplements, transparency masters, instructional supplements, assignment sheets, job sheets, practical tests, written test, and answers to assignment sheets and written test, all of which are included in the instructor's edition. The student workbook includes the objective sheets, information sheets, student supplements, transparency masters, assignment sheets, and job sheets. Written tests may be duplicated for classroom use or *additional copies* may be purchased by calling 1-800-654-4502 or, in Oklahoma, 1-800-522-5810, ext. 589.

All of the unit components tie into measurable and observable learning outcomes. Instructors are encouraged to supplement these components with other resources in order to make them as responsive to local conditions and individual needs as possible.

Most units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the instructor will help him or her determine the following:

- Amount of material that can be covered in each class period.
- Skills that must be demonstrated.
 - Supplies and equipment needed
 - Amount of class time needed for demonstrations
 - Amount of time needed for student practice
- Supplementary materials, including print and non-print media, that must be ordered.
- Resource people who must be contacted.

Objective Sheet (White Pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms. The unit objectives states the overall goal of the unit. It tells what the student should be able to do and what standard will be used to see whether the student can do it. Specific objectives outline the teaching sequence of the competencies required to meet the unit objective.

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Instructors should prepare for each unit by deciding how each objective could be best taught.

Instructors should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the instructor should remember to supply the needed information, assignment and/or job sheets, and criterion-referenced test items.

Suggested Activities (Pink Pages) — Instructor's Edition only

The suggested activities page assists the instructor during the preparation stage of the teaching/learning process by providing suggestions for delivery, application, and evaluation during the instructional process. The instructor should read the suggested activities prior to introducing the unit to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resources. Duties of the instructor will vary according to the particular unit.

References used in the development of each unit are listed in the "Suggested Resources" section, along with print and non-print media that may be used to teach the unit. These materials can be used by the instructor to supplement his or her knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

Extensions and Options (White Pages) — Instructor's Edition only

Extensions and Options are supplemental material that is not testable or graded and is nice-to-know. Extensions and Options provide the instructor with additional activities, fact sheets, art, controversial items, and extra practice sheets. They may also include items for the gifted or remedial student. Extensions and Options are used at the discretion of the instructor.

Information Sheets (Green Pages)

The information sheet provides "must know" content essential for meeting the cognitive objectives stated at the beginning of each unit. It serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective.

Students should read the information sheet before it is discussed in class. Space is provided in margins for students and instructors to add notes that clarify and/or expand on the information provided.

The information sheet may include notes, cautions, or warnings. These should be discussed carefully and thoroughly. **Notes** are short verbal additions to the information sheet or procedural outline that provide nice-to-know and decision-making information. A note may tell the student what to watch for or to consider at a given step. It may explain when a step may not be applicable. Notes offer guidance that may help the student understand the process and do it more efficiently. **Cautions** are advisories that tell the student how to avoid causing minor personal injury or equipment damage. **Warnings** are advisories to the student used to avoid serious personal injury or death to the student, persons in the workplace, or users of the project or the procedure.

Student Supplement (Green Pages)

Student supplements include instructions that could be used for solving problems or reinforcing the enrichment of learning. The information presented in a student supplement may consist of tables, charts, written information, forms, or other information students will need in order to complete one or more of the assignment or job sheets. While supplements are not tested over directly, they may be used to assist in meeting the performance objectives.

Transparency Masters (White Pages) — Instructor's Edition only

Transparency masters provide information in a special way. The students may see as well as hear the materials being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information or assignment sheets.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Instructional Supplements (Pink Pages) — Instructor's Edition only

Instructional Supplements provide suggestions for teaching the basic skills included in each assignment sheet or job sheet. They are located directly in front of the components they support—assignment or job sheets—in each unit.

Assignment Sheets (Tan Pages)

Assignment sheets provide students with information and exercises that address learning levels at or above the application level of Bloom's taxonomy. Assignment sheets provide written exercises for instruction and practice of a specific objective. The introduction to the assignment sheet explains how the assignment sheet relates to the subject area and unit component for such information.

Assignment Sheet Answers (Pink Pages) — Instructor's Edition only

This component is designed to assist the instructor in evaluating student performance on assignment sheets.

Job Sheet (Blue Pages)

Job Sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure to complete each task or job. Diagrams, photographs, and illustration are provided to assist students in achieving the skill.

The instructor should demonstrate the procedure outlined in each job sheet. Furthermore, the instructor needs to localize the procedure according to the equipment and supplies available in the local lab or salon situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Practical Tests (Yellow Pages) — Instructor's Edition only

The practical tests are designed to assist the instructor in the evaluation of the psychomotor activities (job sheets). The practical test provides instructors with a valid mechanism for determining a student's level of ability in performing the procedure stated on the job sheet. The check-off list allows instructors to evaluate a student's process performance of the task on the job sheet. The overall competency indicator allows the instructor to evaluate the end product.

Written Test (Yellow Pages) — Instructor's Edition only

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. If objectives have been added, deleted, or modified, appropriate changes should be made on the test.

In order to measure and document student competency gains as required by the latest Carl Perkins regulations, and as outlined in the Oklahoma-developed system of standards and measures, it is *absolutely essential* that the same test be used as a pretest and as a posttest. If you choose to use tests other than the ones included herein, be sure that the same instrument is used for each activity—pre- and post test.

A detailed explanation of the Oklahoma plan for standards and measures and the Carl Perkins requirements is included in the CIMC publication, *Measuring Learning & Competency Gain: The Pretest/Posttest Approach*. This booklet and accompanying software designed to assist in calculating and recording student gains are available to all vocational teachers through the school's vocational testing liaison.

To further assist vocational teachers, the CIMC is in the process of developing test code sheets for each written test in its more recent publications, including this one. These code sheets are explained in Section 8 of the publication mentioned above, and will greatly assist in verifying that the test is a valid instrument for measuring student learning and competency gains. As the test code sheets for programs become available, they will be forwarded to teachers of each program; further publications will include the test code sheets.

Written Test Answers (Pink Pages) — Instructor's Edition only

This component is designed to assist the instructor in evaluating student performance on written tests.

COMPETENCY PROFILES

A competency profile is in the front of each publication. Competency profiles document student performance. The profile contains a list of the specific job competencies that a student should achieve before leaving the training program.

PAGE NUMBERING

Each publication for the Curriculum and Instructional Materials Center is usually assigned a specific abbreviation. **Introduction to Construction Welding** has not been abbreviated. Each unit will be recognized by the unit number in Arabic numerals. Each unit in the publication begins with page 1. Each page number gives the component name, book title, unit number, and page number within the unit. Since some CIMC publications are loose-leaf, this system of page numbering was recently adopted so that pages from different manuals would not get mixed up. The page number for the objective sheet in *Introduction to Construction Welding*, which is unit 2, would look like this:

OBJECTIVE SHEET - Introduction to Construction Welding
CIMC - A2 - 1

METHODS OF DISSEMINATING MATERIAL

For best results, provide student materials for each student. Student workbooks contain objective sheets, information sheets, supplements, transparency masters, assignment sheets, and job sheets. Pretest, practical tests, and written tests are packaged separately for students, and can be stored until needed. Students should be allowed to take their materials home at the end of the course.

TEACHING METHODS

Keeping students motivated is a challenge. Supplement the objectives by providing the "why," personal experiences, and current information. If you are going to teach the material in a group setting, prepare for the unit by deciding the best way to teach each objective and allow for student input.

If you are going to follow the plan for individualized instruction, provide opportunities that will allow each student to become involved in planning for and being responsible for his or her own education.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Coordinator of Development
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and
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1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

**For a free catalog, a list of new publications,
or other instructional materials information call
1-800-522-5810, extension 589.**

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BASIC SKILLS IN CURRICULUM

The CIMC has always been mindful of the importance of reinforcement (and sometimes remediation) of students' academic skills as they progress through vocational training, and has always included activities in its materials to enhance and promote use of these skills.

Recent state and federal legislation mandates vigorous basic skills development in vocational education in the wake of demands by industry that workers *must* be academically, as well as technically, competent. Given the nature of the highly complex work place. In response, the CIMC has taken the following steps to document that, indeed, the instructional materials *do* combine academic skills training with the vocational training. In addition, concerted efforts have been made to "beef up," or enhance the basic skills instruction already present. Following is a brief description of those processes:

Basic Skills Icons and Enablers

To assist teachers and students in identifying activities that promote basic skills development, the CIMC has implemented a marking system that uses simple graphic symbols, or icons, and a list of specific tasks, or enablers, to identify the basic skill or skills that are called for in each job or assignment sheet.

Each of the nine broad skills areas—reading, writing, mathematics, science, oral communication, interpersonal or relating, creative thinking and problem solving, employability, and social studies—is represented by the icon presented below.



Reading



Science



Creative Thinking/
Problem Solving



Writing



Oral Communication



Employability



Math



Interpersonal or Relating



Social Studies

When an activity involving one of these basic skills is identified, the corresponding icon is placed in the left-hand margin of the job or assignment sheet. The basic skills training is further defined by retrieving the specific, or enabling, skill that is required by consulting a list of over two hundred and fifty enablers that has been compiled and grouped with each general basic skill. This enabling skill is placed directly below the icon.

As an example, an exercise that requires a student to conduct library research would make necessary the use of specific reading comprehension and research and reference skills. The basic skills that the exercise promotes would be depicted in the left-hand margin as follows:

ASSIGNMENT SHEET	PLANNING LIVING SPACE FOR HUMAN NEEDS 1	
OBJECTIVE 10 INSTRUCTIONS  <u>Reading Comprehension</u> • Gain factual information <u>Functional Reading</u> • Follow written instructions • Use content area vocabulary  <u>Language</u> • Use standard grammar, spelling, and capitalization • State ideas clearly	Name _____ Score _____ Define personal territory. • As discussed in Objective 1, each person has an invisible "space bubble" or comfort zone. A comfort zone is the space between oneself and others that brings a feeling of well-being. When one's comfort zone is crowded or invaded, discomfort often results. Therefore, personal territory needs should be a prime consideration when planning living space. • For each of the following situations, draw your estimated comfort zone around the figures provided. • Indicate how many inches from your body the comfort zone extends. • Consider how that comfort zone changes in different situations. Answer the questions that follow.	

Basic Skills Documentation Matrix

Another component of the CIMC basic skills instructional plan is the "Basic Skills Documentation Matrix." The matrix graphically summarizes the basic skills training included in the vocational program, unit by unit. It should be helpful to teachers in planning their instruction, and to administrators as documentation that basic skills **are** being addressed during the vocational training.

The matrix for this publication is included as an 8½" by 11" foldout in this *Instructor's Manual*.

Matrices have been developed for most CIMC publications. For more information on those available for other programs, call the CIMC at 1-800-654-4502.

Instructional Supplement

The supplement is a tool for the instructor to use in helping students apply the basic skills in Assignment Sheets and Job Sheets. Some supplements are appropriate for use with all students; some are for use only with those students who do not understand the academic skills called for in the exercise.

MEASURING STUDENT PERFORMANCE GAINS

When you examine this book, you will notice that separate written pretests are no longer included in the units of instruction. Each CIMC unit now contains only a single Written Test. This test should be used as **both** pretest and posttest by giving it once before students start a unit and again when they have completed the unit.

The reason for using a single instrument as both pretest and posttest is so that direct comparison of each student's competencies before and after instruction can be made accurately. This comparison enables precise calculation, documentation, and evaluation of student **performance gains**.

Accurate performance gains analysis is an important requirement of the new Carl Perkins legislation for vocational education. Teachers can make an important contribution to the performance accountability mandated by the new federal legislation by carrying out accurate performance gains analysis for their students, and making this data available to students, parents, and administrators.

This analysis is easy to do and requires only simple calculations and record keeping. Detailed information regarding performance gains analysis is contained in the CIMC publication, *Measuring Learning & Competency Gains: The Pretest/Posttest Approach*. In addition, the CIMC has developed a computer program, CARL, which will perform all necessary calculations and will print out a record form of all information required for gain score analysis. Copies of CARL and the publication are available through your local testing liaison (in Oklahoma), or from the CIMC at 1-800-654-4502.

REQUIRED CRITERIA FOR A COMPETENCY-BASED EDUCATION PROGRAM

Criterion	Discussion	CIMC component meeting criterion
1. Instruction is based on clearly-stated learning objectives that are: a) observable and measurable, and b) communicated in writing to students before instruction begins.	Learning objectives drive CBE. Objectives are the "competencies" that learners must achieve. Each objective must clearly state what learners must <i>do</i> to demonstrate acquired skill or knowledge. Verbs in learning objectives are active and precise, stating the exact performance expected of learners. The objectives should also specify the standard or level of performance required. Objectives can be at any level of Bloom's Taxonomy and can include the cognitive, psychomotor, and affective domains. Higher-order cognitive skills should be included.	Objective Sheet
2. Instruction is aligned with the stated learning objectives	In CBE, the objectives specify what is taught. "Content" should relate to one or more objectives. The curriculum should cover all objectives with relevant information.	Information Sheet
3. There is a student evaluation system that is: a) criterion-referenced, and b) aligned to the learning objectives and the curriculum.	In CBE, the aim is to bring the performance of <i>all</i> learners up to a pre-defined standards and competencies. Learners work on each competency until they achieve "mastery"; the evaluation system should test and record this mastery. Learners can restudy and retest as often as needed. Specific remediation activities should also be available to learners when needed. The evaluation system focuses on what each student has achieved, not on what the instructor has "taught." The "constant" in CBE is student performance; the "variables" are time and resources. (This differs from traditional systems where learners get one chance at mastery; some succeed and some fail. In such systems, time and resources are constant and student achievement is variable.) If an evaluation is criterion-referenced, successful learner performance is defined by (or <i>referenced</i> to) mastery of pre-set objectives and standards (or <i>criteria</i>); there must be a careful match (or <i>alignment</i>) between what the student should master (objectives), what is taught (curriculum), and what is tested. Objectives, curriculum, and evaluation system must all match.	Written Test and Job Sheet/Skill Test

Criterion	Discussion	CIMC component meeting criterion
4. There is an observable management system of cognitive skill practice that provides for, promotes, and documents mastery learning.	For both cognitive and psychomotor skills, a CBE program must have a system of maintaining records of which skills and activities each learner has completed, which ones are in progress, and which ones have not yet been completed. Completion means "mastery"; no skill is completed until the learner has achieved the mastery level. The record system should promote feedback on student skill attainment to both instructor and learners, provide for remediation as needed, and encourage reevaluation of learner performance until mastery is achieved. Appropriate remediation strategies often should consider learning styles and other individual differences among learners.	Assignment Sheet
5. There is an observable management system of psychomotor skill practice that provides for, promotes, and documents mastery learning.	Learners should work on skills and activities until they achieve mastery. They should not be "passed on" without mastery. While learners may move ahead and work on other skills (i.e. those for which all prerequisite skills have been mastered or those without prerequisites), work should also continue on the skills still requiring mastery. Students should not attempt higher-order skills until all prerequisite skills are mastered.	Job Sheet/Skill Test
6. Skill mastery records are maintained for each learner, and learners have access to and make use of these records to monitor their skill acquisition.	Records should clearly indicate the skills each learner has mastered. One such record should profile or list the competencies that have been mastered and those to be mastered. Other performance indicators can be added and kept in a portfolio for each learner. Learners should have ready access to their portfolios to monitor their own progress in skill mastery and competency attainment.	Competency Profile

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This information will be used to correct the publication before the materials are reprinted. To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error.

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OBJECTIVE SHEET	WELDING MATERIAL A 1
INTRODUCTION	This unit introduces you to the basic terms and material used in construction welding. There are many welding methods used throughout the welding industry. The methods used during this welding introduction include soldering, brazing, oxyacetylene, and electric arc welding.
PREREQUISITE	<i>Fundamentals of Construction</i>
UNIT OBJECTIVE	After completing this unit, the student will be able to define basic welding terms and identify materials. The student will demonstrate these competencies by completing the assignment sheet and written test with a minimum of 85 percent accuracy.
SPECIFIC OBJECTIVES	After completing this unit, the student will be able to show the ability to: 1. Given a list of terms associated with welding materials, match them to their correct definitions. 2. With a definition given, pick the correct metal bonding method. 3. Choose metal types according to their characteristics. 4. Select the word or phrase that correctly completes statements concerning preheating and postheating of metals. 5. Match temperature-sensing devices to their correct applications. 6. Provided a list of common electrode sizes and types, select those used in arc welding. 7. Identify standard metal shapes. (Assignment Sheet)



SUGGESTED ACTIVITIES	WELDING MATERIALS A 1
PREPARATION	• Review unit and plan presentation. • Order or obtain materials to supplement unit. • Introduce unit.
DELIVERY	Objective 1: Given a list of terms associated with welding materials, match them to their correct definitions. • Use the Information Sheet to discuss terms and definitions associated with welding materials. • Point out how knowing these terms and definitions will help students to better understand the unit. • Show students examples of terms when appropriate. Objective 2: With a definition given, pick the correct metal bonding method. • Describe the four basic types of metal bonding used in construction. Objective 3: Choose metal types according to their characteristics. • Use the Information Sheet to discuss basic types of metals. • Show samples of various types of metals; explain the differences to the students. • Use Transparency 1 to discuss metal melting points. Objective 4: Select the word or phrase that correctly completes statements concerning preheating and postheating of metals. • Discuss the different types of heat applications and their uses.



- Discuss situations where preheating is usually required.
- Discuss the methods used for preheating and postheating.

Objective 5: Match temperature-sensing devices to their correct applications.

- Provide samples of the various types of temperature-sensing devices, and allow the students to examine them. Explain how they work.
- Discuss and demonstrate how each of the devices should be used.

Objective 6: Provided a list of common electrode sizes and types, select those used in arc welding.

- Discuss various sizes of electrodes. Show students examples of each size and allow students to examine them.
- Point out the types of information that can be obtained from the electrode selection wall chart and the electrode pocket guide books.
- Use an electrode handbook and Transparency 2 to discuss selection of electrodes; relate electrodes commonly used on the job to their uses.
- Explain that on the electrode selection wall chart, different current settings are suggested for different thicknesses of metal and different electrode sizes.

APPLICATION

Objective 7: Identify standard metal shapes. (Assignment Sheet)

- Provide samples of each of the different shapes of metal for the students to see, feel, and examine.
- Explain where and how each shape of metal may be used.
- Allow students to practice identification of standard metal shapes by completing the assignment sheet.



EVALUATION

- Use an AISC book to describe other metal shapes.

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

NOTE: The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.



**SUGGESTED
RESOURCES**

- *Mechanical Steel Construction.* American Institute of Construction, Inc. (AISC), 400 N. Michigan Ave., Chicago, IL 60611

**UNIT
REFERENCES**

- Althouse, Andrew. *Modern Welding.* Goodheart-Willcox Company, Inc., South Holland, IL 1992.
- Fortney, Clarence, and Mike Gregory. *Introduction to Welding.* Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc.
- Willey, Al. *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma Department of Vocational and Technical Education/ Curriculum and Instructional materials Center and The Associated General Contractors of America, 1993.



OBJECTIVE 1

Given a list of terms associated with welding materials, match them to their correct definitions.

- **amperage** — a measure of electrical current; in electric welding, amperage is the measure used to determine the heat required to bond metals.
- **brazing** — process of joining two metals together by heating the base metal to a dull red color and depositing a bead over the seam (joint) with a bronze filler rod, without melting the base metal
- **electrode** — a metallic or carbon rod used in electric arc welding as filler metal
- **filler metal** — metals added when brazing, welding, or soldering
- **interpass heating** — application of heat to a base metal during a welding process
- **oxidation** — the formation of rust when iron or other metals combine with oxygen in the presence of moisture
- **postheating** — application of heat to metal after a welding or cutting operation to promote a slower cooling rate and relieve stresses in the base metal and the weld
- **preheating** — application of heat to a base metal before welding or cutting
- **rosebud** — a term used to describe the shape of the flame or the design of the torch tip producing it
- **soldering** — process of joining soft metals together by melting a metal or metallic alloy and depositing a bead over the seam to unite the two pieces together



- **welding** — process of joining two metals together by heating them with a torch or an electric arc, with or without filler metal
- **welding rod** — the metallic or carbon-based shaft melted as a filler material during welding

OBJECTIVE 2

With a definition given, pick the correct metal bonding method.

- Common metal bonding methods used in construction:

- Soldering

Soldering bonds metal by melting certain types of metal filler material such as tin, lead, or tin-lead alloys.

Soldering irons and torches are used to heat the base metals and melt the filler material.

- Brazing

Brazing is a bonding method in which metals are joined in a similar manner as in soldering. Brazing requires greater heat to be applied in order to melt the filler material. Copper and zinc alloys are common filler material for brazing.

- Oxyacetylene welding

This method combines oxygen and acetylene gases to produce a high temperature flame for welding. The flame heats the base metals and melts the welding rod.

- Electric arc welding

This welding method uses an electrical current (amperage) to melt an electrode (welding rod or stick) and bond the metals.



OBJECTIVE 3

Choose metal types according to their characteristics.

NOTE: It is important that you be able to identify metal types. The selection of electrode types, amperage ratings, and welding methods are based on the metal type.

- Categories of metals
 - Ferrous — Metals that contain iron as a major element

EXAMPLES: Low, mild, medium, and high carbon steels; cast iron
 - Nonferrous — Metals that contain no iron or extremely small amounts of iron

EXAMPLES: Aluminum, copper, zinc, lead, tin, nickel, silver, titanium, and gold
- Identification of metals by their characteristics
 - Magnetic

A magnet will stick to ferritic alloys, but it will not stick to nonferritic.
 - Hardness

Nonferrous metals can usually be filed easily, and ferrous metals are more difficult to file.
 - Spark patterns while welding

Metals have definite spark patterns.
 - Reaction to chemicals

Certain chemicals or acids applied to metals cause different reactions.

EXAMPLE: A weak solution of nitric acid or copper sulfate applied to stainless steel will remain clear but will darken when applied to carbon steel.



— Appearance

General surface appearance, color, and the presence of oxidation may be helpful in identification.

EXAMPLE: Some metals exposed to weather will rust; others will tarnish, and others will remain free of oxidation.

— Sound

When struck with a hammer, most metals have a characteristic.

EXAMPLE: Steel has a high-pitched ring. Cast iron has a low-pitched ring.

— Composition

When chipped with a chisel, certain metals produce a continuous chip; others break up into small particles, and still others cannot be chipped.

EXAMPLE: Low carbon steel chips easily and leaves a continuous chip, but cast iron is not easy to chip and breaks up into small chips.

— Melting point

Metal types melt at different temperatures ranging from approximately 450 degrees to over 6000 degrees F. Lead and tin have low melting points. Steel and cast iron have much higher melting points.



OBJECTIVE 4

Select the word or phrase that correctly completes statements concerning preheating and postheating of metals.

- Situations when preheating is usually required
 - When large or bulky parts are being welded, or when parts being welded have a complicated shape
 - When the atmospheric temperature is cold or the temperature of the parts is cold
 - When the carbon or alloy content of steel is high
 - When the welding speed is fast
 - When small-diameter welding rods are used
- Methods of preheating and postheating
 - Furnaces
 - Electrical strip heaters clamped parallel to joints about 6" from the seam
 - Acetylene or propane torches used singly or in banks of two or more
 - Torch heating using natural gas and compressed air with a single-orifice heating tip the same size that would be used to oxyacetylene weld the joint

NOTE: This method is used frequently in shop work because it gives a hot flame that burns cleanly and helps prevent contaminating the weld zone.

 - Torch heating using multiflame heads or rosebuds



OBJECTIVE 5

Match temperature-sensing devices with their correct applications.

- Temperature-sensing devices and their applications
 - Pyrometers — Portable thermometers specifically designed to measure surface heat
 - Thermocouples — Temperature-sensing devices that may be attached to the work, but are more often used in heating ovens and postweld heat treatment
 - Crayons and pellets — Temperature-sensing devices that melt suddenly when the work reaches a specific temperature

NOTE: Crayons are usually color-coded for specific temperatures and are frequently used in pairs to indicate a low and high range of heating so that desired temperatures can be more accurately determined.

OBJECTIVE 6

Provided a list of common electrode sizes and types, select those used in arc welding.

- Electrode sizes

NOTE: Electrodes range in sizes from $\frac{1}{16}$ to $\frac{5}{8}$ inch. Those sizes most common are listed below.

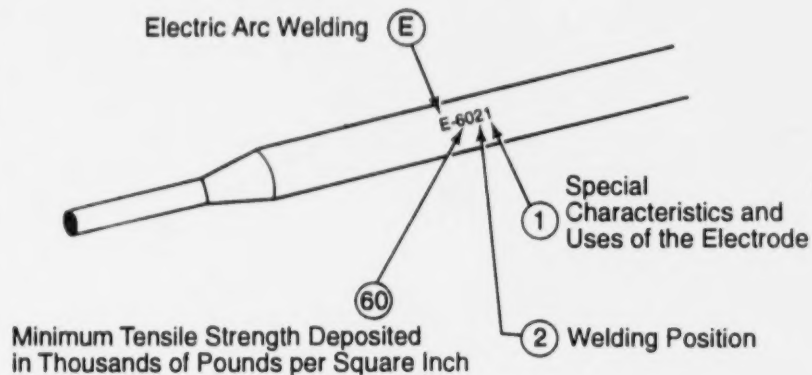
- $\frac{3}{32}$ "
- $\frac{1}{8}$ "
- $\frac{5}{32}$ "
- $\frac{3}{16}$ "

NOTE: Always follow the electrode manufacturer's recommendations when selecting and using electrodes. There are dozens of electrode sizes, types, and ratings; be sure to observe the identification number on the electrode to be sure that its characteristics meet your requirements.



- Identify electrode types
 - Welding electrodes characteristics are identified by an AWS code inscribed on the body of the rod. (Figure 1)

FIGURE 1



- For an E-6021 rod
 - A. E — Electric arc welding
 - B. First two digits (60) — Minimum tensile strength deposited in thousands of pounds per square inch
 - C. Third digit (2) — Welding position
 - 1. One — Indicates all positions
 - 2. Two — Indicates flat and horizontal only
 - 3. Three — Indicates flat only
 - D. Fourth or last digit (1) — Special characteristics and uses of the electrode

OBJECTIVE 7

Identify standard metal shapes. (Assignment Sheet 1)

- Standard metal shapes available for welding

— Round bar

FIGURE 2



— Half-round bar

FIGURE 3



— H-beam or wide flange

FIGURE 4



— Oval bar

FIGURE 5



— I-beam

FIGURE 6



— Half-oval bar

FIGURE 7



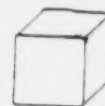
— Channel

FIGURE 8



— Square bar

FIGURE 9



— Hexagon bar

FIGURE 10



— Angle

FIGURE 11



— Flat bar

FIGURE 12



— Tee

FIGURE 13



— Flat sheet

FIGURE 14



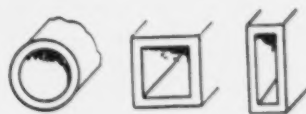
— Zee

FIGURE 15



— Tubing and pipe

FIGURE 16



— Rail

FIGURE 17

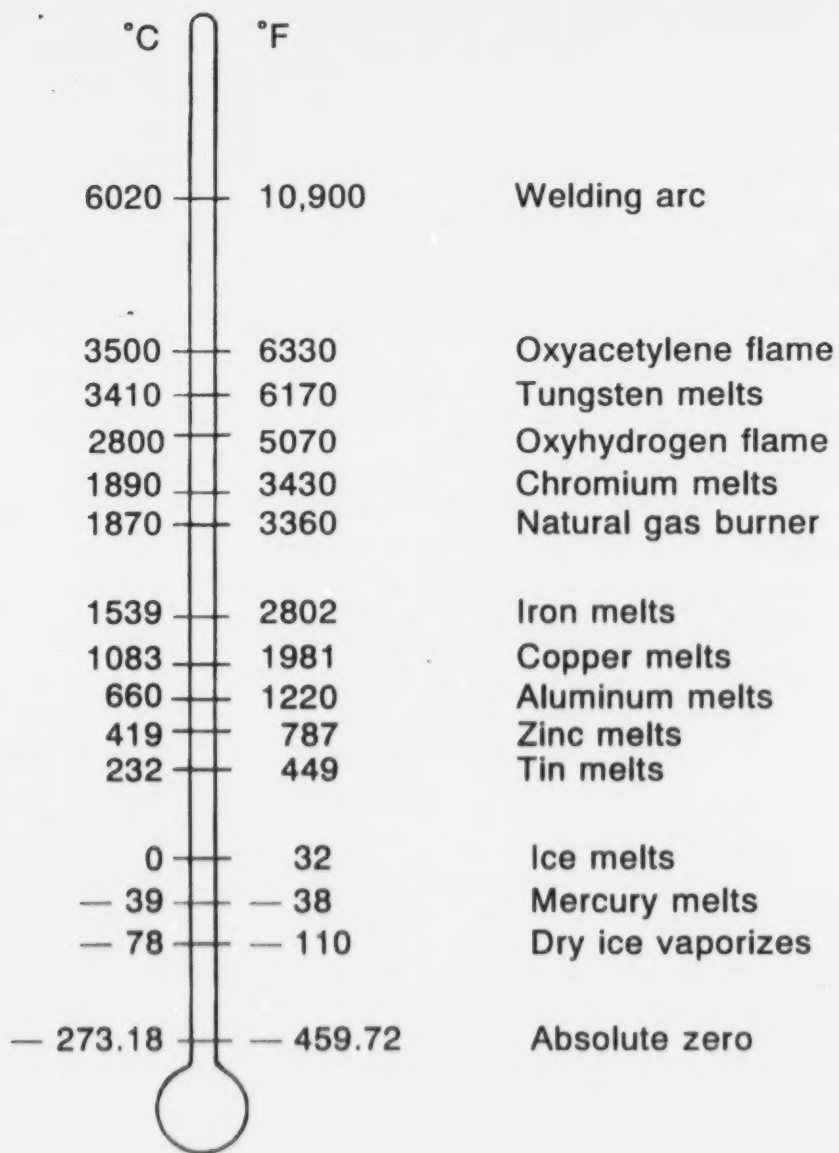


— Flat plate

FIGURE 18



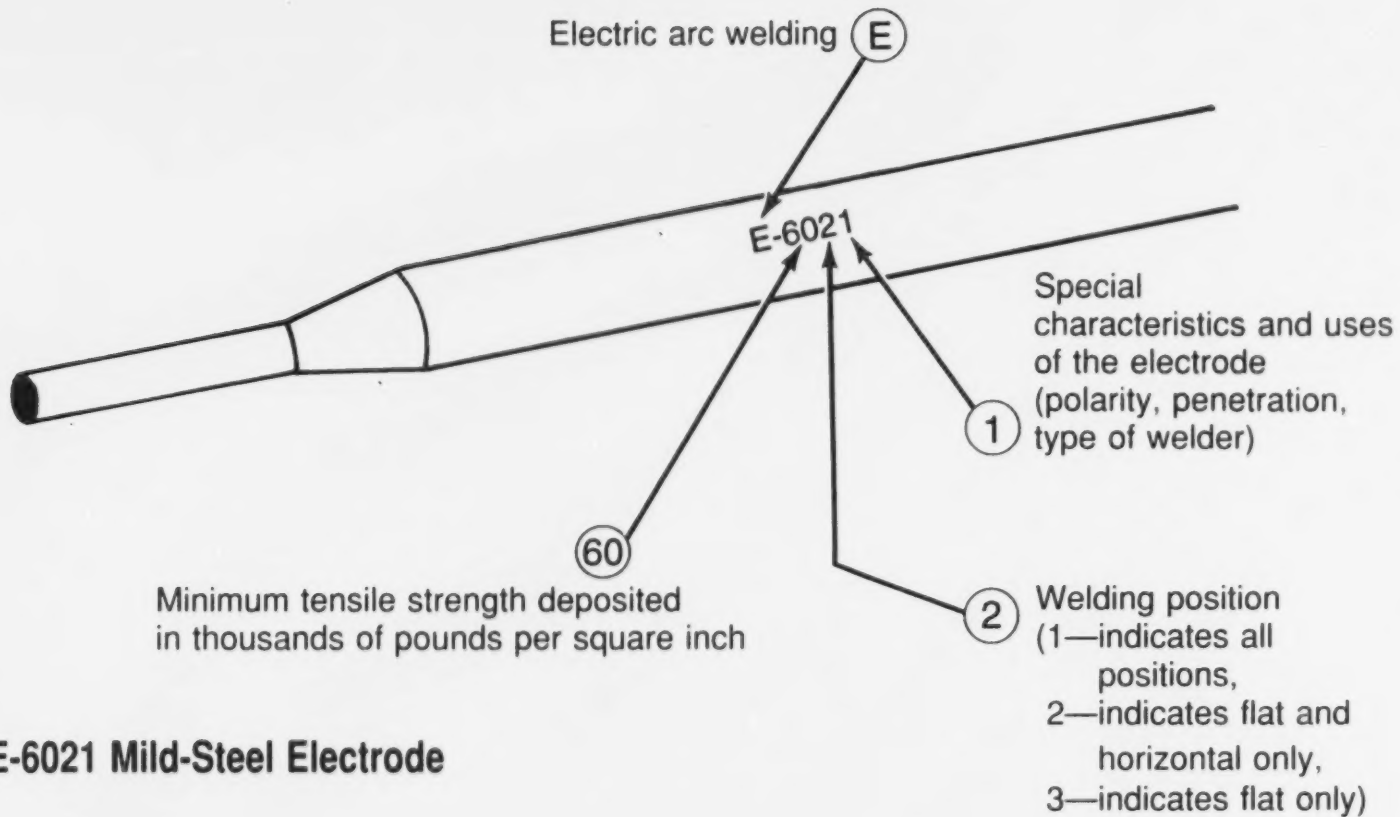
Metal Melting Points



Courtesy Lincoln Electric Company



AWS Electrode Classification System



**ASSIGNMENT
SHEET**

WELDING MATERIALS

A 1

Name _____ Score _____

OBJECTIVE 7

Identify standard metal shapes.

INTRODUCTION

Practice identifying standard metal shapes by matching them to their proper names.

INSTRUCTIONS



Functional Reading

- Follow written instructions



Language

- Use standard grammar, spelling, and capitalization



Job Acquisition/
Development

- Master specific job task/procedure

Match the metal shapes to their proper names.

H-beam/wide flange
Half-oval bar
Half-round bar
Tee
Flat sheet
Hexagon bar
Flat bar
Rail

Round bar
Channel
Oval bar
Square bar
Angle
Zee
Tubing and pipe



1. _____

2. _____



3. _____

4. _____





5. _____



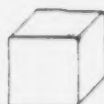
6. _____



7. _____



8. _____



9. _____



10. _____



11. _____



12. _____



13. _____



14. _____





15. _____



ASSIGNMENT ANSWERS	WELDING MATERIALS	A 1
-----------------------	-------------------	-----

ASSIGNMENT
SHEET 1

1. Rail
2. Hexagon bar
3. Tubing and pipe
4. Round bar
5. Channel
6. Half-round bar
7. Zee
8. Tee
9. Square bar
10. Angle
11. H-beam/wide flange
12. Oval bar
13. Flat sheet
14. Half-oval bar
15. Flat bar



WRITTEN TEST	WELDING MATERIALS	A 1
-------------------------	--------------------------	------------

Name _____ Score _____

OBJECTIVE 1

Given a list of terms associated with welding materials, match them to their correct definitions. Write the letter that corresponds to the most correct answer.

- _____ 1. A measure of electrical current is
 - a. amperage
 - b. voltage
 - c. resistance
 - d. wattage

- _____ 2. A metallic or carbon rod used in electric arc welding as filler material is called
 - a. solder
 - b. filler bar
 - c. rosebud
 - d. electrode

- _____ 3. The application of heat to a base metal before welding or cutting is known as
 - a. preheating
 - b. postheating
 - c. heat sensing
 - d. torch bonding

- _____ 4. The process of joining two metals together by heating them with a torch or an electric arc is
 - a. brazing
 - b. soldering
 - c. welding
 - d. bonding

May be photocopied for student use.



- _____ 5. Metals added when brazing, welding, or soldering are called
- a. melted metals
 - b. filler metals
 - c. compounds
 - d. interpass metals
- _____ 6. A term used to describe the shape of the flame or the design of a torch tip is a
- a. bloom
 - b. rosebud
 - c. preheat tip
 - d. over-size tip
- _____ 7. The process of joining two metals together by heating the base metal and depositing a bead over the joint with a metal filler rod is called
- a. preheating
 - b. interpass heating
 - c. brazing
 - d. soldering
- _____ 8. The application of heat to a base metal during a welding process is called
- a. rodding
 - b. postheating
 - c. oxidation process
 - d. interpass heating

OBJECTIVE 2

With a definition given, pick the correct metal bonding method.

- _____ 1. A bonding method in which tin, lead, or a tin-based alloy is used as a filler material is
- a. soldering
 - b. brazing
 - c. electric arc welding
 - d. interpass bonding

May be photocopied for student use.



- _____ 2. The bonding method in which gases are burned to produce a high temperature flame is known as
- a. interpass bonding
 - b. heat welding
 - c. electric arc welding
 - d. oxyacetylene welding
- _____ 3. The welding method that uses an electrical current to melt an electrode to bond metals is called
- a. electroanalysis
 - b. electrical bonding
 - c. electric arc welding
 - d. electrical interpass

OBJECTIVE 3

Choose metal types according to their characteristics.

- _____ 1. Metals that contain iron as a major element are known as
- a. nonferrous metals
 - b. titanium alloys
 - c. oxide metal
 - d. ferrous metals
- _____ 2. Copper contains no iron and is a/an
- a. ferrous metal
 - b. nonferrous metal
 - c. alloy
 - d. carbonless oxide
- _____ 3. The presence of oxidation on the surface of a metal could identify it as
- a. copper
 - b. sulfate
 - c. aluminum
 - d. iron

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- _____ 4. A type of metal that is not easy to chip but breaks up into small chips is likely composed of
- a. aluminum
 - b. steel
 - c. cast iron
 - d. nickel alloy
- _____ 5. When struck with a hammer, this metal has a high-pitched ring
- a. steel
 - b. cast iron
 - c. gold
 - d. copper
- _____ 6. Using a torch, you discover a metal melts at a low temperature. The metal is most likely to be
- a. steel
 - b. lead
 - c. cast iron
 - d. iron

OBJECTIVE 4

Select the word or phrase that correctly completes statements concerning preheating and postheating of metals.

- _____ 1. Preheating is usually required when the carbon or alloy content of _____ is high.
- a. iron
 - b. aluminum
 - c. steel
 - d. copper
- _____ 2. Preheating is usually required when _____ and _____ parts are being welded.
- a. small, thin
 - b. undersize, metal
 - c. large, bulky
 - d. copper, bronze

May be photocopied for student use.

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- _____ 3. Preheating the base metal is required when the parts and the _____ are cold.
- a. atmospheric temperature
 - b. welding rods
 - c. compressed air
 - d. rosebud tip
- _____ 4. Postheating is generally done by a method which utilizes
- a. furnaces
 - b. heat lamps
 - c. solar panels
 - d. friction bars
- _____ 5. All of the following are used for preheating or postheating except
- a. oxyacetylene torch
 - b. acetylene torch
 - c. propane torch
 - d. natural gas and compressed air torch
- _____ 6. Electrical strip heaters used for preheating and postheating are placed about _____ inches from the seam.
- a. 4
 - b. 5
 - c. 6
 - d. 8

OBJECTIVE 5

Match temperature-sensing devices with their correct applications.

- _____ 1. Temperature-sensing devices that melt suddenly when the work reaches a specific temperature are known as
- a. thermocouples
 - b. pellets
 - c. pyrometers
 - d. melt pods

May be photocopied for student use.



- _____ 2. Portable thermometers specifically designed to measure surface heat are
- a. thermo-crayons
 - b. pyrometers
 - c. thermocouples
 - d. pellets
- _____ 3. Temperature-sensing devices that are often used in heating ovens and postweld heat treatments are
- a. pyrometers
 - b. crayons and pellets
 - c. thermoconductors
 - d. thermocouples

OBJECTIVE 6

Provided a list of common electrode sizes and types, select those used in arc welding.

- _____ 1. Which of the following is NOT a common electrode size?
- a. $\frac{1}{8}$ "
 - b. $\frac{5}{32}$ "
 - c. $\frac{3}{16}$ "
 - d. $\frac{7}{8}$ "
- _____ 2. Of the following electrode sizes, which one is commonly used in arc welding?
- a. $\frac{3}{32}$ "
 - b. $\frac{7}{16}$ "
 - c. $\frac{9}{16}$ "
 - d. $2\frac{9}{32}$ "
- _____ 3. The "E" classification for welding rods/electrodes indicates it is to be used with a/an
- a. electric soldering gun
 - b. heavy metal types
 - c. oxyacetylene welder
 - d. electric welder

May be photocopied for student use.

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NOTE: Objective 7 is evaluated on an assignment sheet in this unit. If you have not completed this component, see your instructor.

May be photocopied for student use.

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WRITTEN TEST ANSWERS	WELDING MATERIALS	A 1
OBJECTIVE 1	1. a 5. b 2. d 6. b 3. a 7. c 4. c 8. d	
OBJECTIVE 2	1. a 2. d 3. c	
OBJECTIVE 3	1. d 4. c 2. b 5. a 3. d 6. b	
OBJECTIVE 4	1. c 4. a 2. c 5. a 3. a 6. c	
OBJECTIVE 5	1. b 2. b 3. d	
OBJECTIVE 6	1. d 2. a 3. d	
OBJECTIVE 7	This objective is evaluated through the completion of the Assignment Sheet.	



CIMC TEST CODE SHEET

VOCATIONAL PROGRAM (BOOK TITLE) INTRODUCTION TO CONSTRUCTION WELDING

UNIT NUMBER AND TITLE A1 – WELDING MATERIALS

TOTAL NUMBER OF TEST QUESTIONS 29

TOTAL NUMBER OF BASIC SKILL QUESTIONS 16

OBJECTIVE NUMBER	TEST QUESTION NUMBER(S)	BASIC SKILL CODE(S)
1	1	S
1	2-8	X
2	1-3	S
3	1-6	S
4	1-3	S
4	4-6	X
5	1-3	S
6	1-3	X

OBJECTIVE SHEET	WELDING TOOLS AND EQUIPMENT A 2
INTRODUCTION	Welding requires the safe and efficient use of tools and equipment. This unit will allow you to identify common welding tools and equipment. Working with metals can increase your exposure to accidents and injuries. This unit describes the most common sources of danger and the recommended preventive measures.
PREREQUISITE	<i>Fundamentals of Construction</i>
UNIT OBJECTIVE	After completing this unit, the student will be able to identify tools and state safety guidelines for welding. The student will demonstrate these competencies by completing the assignment sheet and written test with a minimum of 85 percent accuracy.
SPECIFIC OBJECTIVES	After completing this unit, the student will be able to show the ability to: 1. Given a list of terms and abbreviations associated with welding tools and equipment, match them to their correct definitions. 2. State the purpose of the major components of common equipment used in electrical arc and oxyacetylene welding. 3. From a list of alternatives, choose the proper safety guidelines for the use of welding tools and equipment. 4. Choose the word or phrase that correctly complete statements concerning the proper care of welding tools and equipment. 5. Identify welding tools and equipment by their drawings or designated uses. (Assignment Sheet)



SUGGESTED ACTIVITIES	WELDING TOOLS AND EQUIPMENT A 2
PREPARATION	• Review unit and plan presentation. • Order or obtain materials to supplement unit. • Introduce unit.
DELIVERY	Objective 1: Given a list of terms and abbreviations associated with welding tools and equipment, match them to their correct definitions. • Use the Information Sheet to discuss terms and definitions associated with welding tools and equipment. • Have students review terms. • Discuss, demonstrate and show examples of appropriate terms that may be unfamiliar to students. Objective 2: State the purpose of the major components of common equipment used in electrical arc and oxyacetylene welding. • Use Transparency 1 and 2 to discuss major components. • Take students on a tour to a shop to see the various types of welding machines. • Point out that welding machines using a stick electrode are referred to as "shielded metal arc welding" (SMAW); welding on a TIG machine is referred to as "gas tungsten arc welding" (GTAW); and welding on a MIG machine is referred to as "gas metal arc welding" (GMAW). • Give examples of the uses for each kind of welding machine. • Invite a local supplier to discuss kinds of welding machines and their uses.



- Show the video *Superwelder*.
- Show the film *Arc Welding/Methods*.

Objective 3: From a list of alternatives, choose the proper safety guidelines for the use of welding tools and equipment.

- Use Information Sheet to discuss guidelines for the safe use of welding hand tools and equipment.
- Have students explain details of accidents they know of in which someone used tools and equipment improperly.
- Discuss newspaper clippings of case studies that relate to safe use of tools and equipment.
- Demonstrate to students how to clean and store tools properly.
- Explain your policy for replacement and repair of damaged tools.
- Outline your tool-management policy for your shop.
- Show the video *Arc Welding Safety*.

Objective 4: Choose the word or phrase that correctly complete statements concerning the proper care of power tools and equipment.

- Use the Information Sheet to discuss guidelines for the proper care of power tools and equipment.

APPLICATION

Objective 5: Identify welding tools and equipment by their drawings or designated uses. (Assignment Sheet)

- Use tool and equipment catalogs to show examples of those types of welding equipment you can not physically show your students.
- Allow students to practice the procedures in the assignment sheet.



EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

NOTE: The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.



SUGGESTED RESOURCES

Electronic Media

- *Arc Welding Methods*, Association Films, 600 Grand Avenue, Richfield, NJ 07657. This film explains major arc welding processes, related equipment, and progress made in the field, (16mm—30 minutes, color).

NOTE: It is available to Oklahoma teachers on a free-loan basis from the Oklahoma Department of Vocational and Technical Education/Curriculum and Instructional materials Center Film Library, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364. Other teachers must order from the address listed above.

- *V218 Arc Welding Safety*. TEL-A-TRAIN, 309 N. Market St., Chattanooga, TN 37405. This guide to safe arc welding covers both the dangers involved with arc welding and the best ways to prevent accidents. Power supplies, grounding, and polarities are discussed in detail. This program also covers fire/electrical hazards. (21 minutes, color, VHS)
- *Superwelder*, V030. This program is about the basics of welding and cutting, such as wearing proper clothing, securing and ventilating the area, using tools, and protecting eyesight and hearing. (½" video, color, 17 min. 1986, AITE)
- Fortney, Clarence and Mike Gregory. *Introduction to Welding*. Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc. 1984.
- Willey, Al. *Fundamentals of Carpentry*. Stillwater, Oklahoma: Oklahoma Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1993.

UNIT REFERENCES



OBJECTIVE 1

Given a list of terms and abbreviations associated with welding tools and equipment, match them to their correct definitions.

- **AC** — alternating current; electric current that reverses its direction at regular intervals
- **arc** — flow of current across a narrow gap, usually from the tip of electrode to a base metal
- **arc welding** — joining of two or more pieces of metal by fusion process

NOTE: Arc welding is sometimes referred to as "SMAW" or "stick welding."

- **AWS** — American Welding Society
- **burning goggles** — special goggles with shaded lenses to protect eyes from exposure to intense light
- **DC** — direct current; electric current flowing in one direction only and generally constant in value
- **fusion** — process of liquefying by melting
- **GMAW** — gas metal arc welding
- **ground fault circuit interruption (GFCI)** — special circuits used to protect workers from electrical shock when using AC powered tools and equipment
- **keyway** — groove cut into a shaft to accept a key
- **lead** — cable leading from ground clamp and electrode holder to the welding machine
- **MIG** — a method of welding metals, also called gas metal arc welding or GMAC



- **OSHA** — Occupational Safety and Health Act; federal legislation designed to ensure safe and sanitary working conditions for employees
 - **oxyacetylene welding** — a method of welding softer metals such as copper or bronze; soldering and brazing are common examples of oxyacetylene welding
 - **psi** — pounds per square inch
 - **slag** — nonmetallic porous material trapped in the weld metal or between the weld metal and base metal
 - **SMAW** — shielded metal arc welding
- EXAMPLE: Arc welding
- **tacking** — process of temporarily welding parts in alignment until the final welds are made
 - **TIG** — a method of welding metals, also called gas tungsten arc welding or GTAW
 - **tolerance** — acceptable variation from a standard size

OBJECTIVE 2

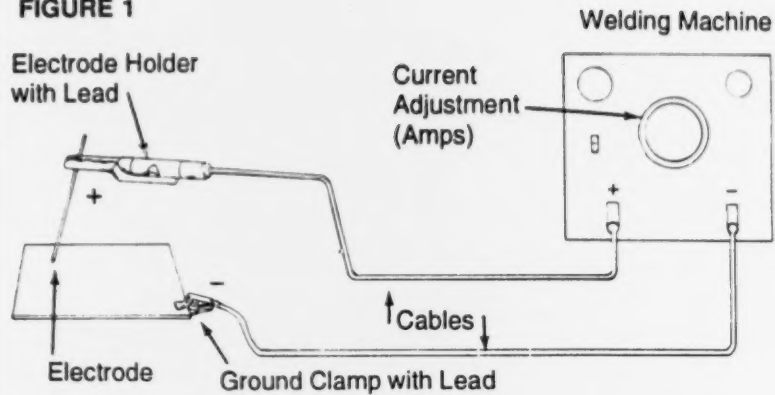
State the purpose of the major components of common equipment used in electrical arc and oxyacetylene welding.

NOTE: Although there are many types of welding equipment, electrical arc and oxyacetylene cutting, soldering, and brazing are the types most often used at construction sites.

- Electrical arc welding



FIGURE 1



— Welding machines

Welding machines produce an electric arc between the metal electrode and the metal being welded. The heat generated by this arc melts both the electrode end and the base metals and fuse them together.

— Current (amperage) adjustment

The welding machine provides an adjustment for the amount of current flow or heat required to create metal fusion. The setting depends on the base metal type, its thickness, and the type of electrode being used.

— Insulated cables

Cables carry the current to and from the electrode end. To produce the electrical arc, a complete current path must exist. Generally, a loose ground clamp will open the current path and prevent welding.

— Electrodes and electrode holder

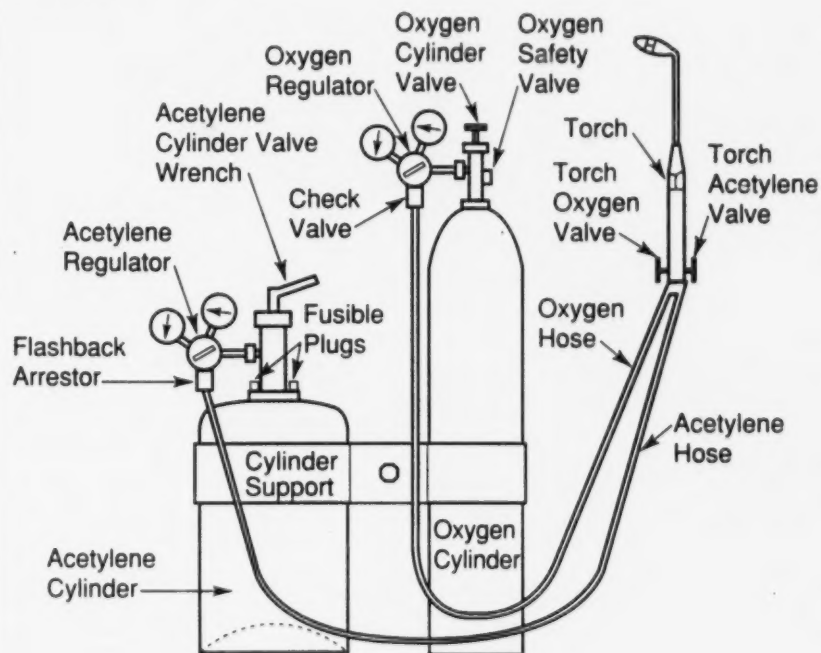
The electrode holder is insulated to protect the welder from electrical shock and heat.

The electrode is also called the stick or the welding rod. Electrodes can be purchased in many sizes and types, each designed for a specific welding application.

Electrodes have standard identification marks stamped on them. The standards were established by the AWS and provide welders with common electrode identification standards, regardless of the electrode manufacturer.

- Oxyacetylene welding

FIGURE 2



- Prime purpose

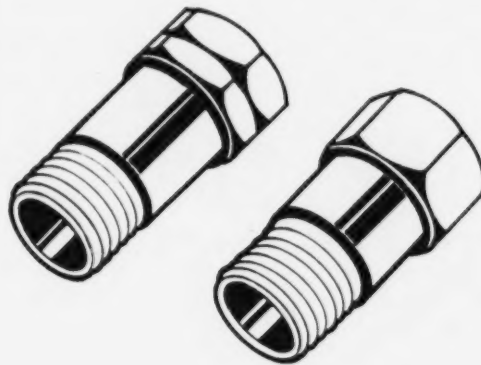
At the construction site, oxyacetylene welding units are used to cut, solder, or braze metals.

- Cylinders store acetylene gas and oxygen used as the fuel source for heating/welding.



- Torches are used to control the gas mixture and concentrate the flame to the base metal to be cut/welded. There are many types of torches—all heat the metal filler material (such as solder) and the base metal.
- The hoses carry the gases to the torch for burning. The hoses must contain check valves and flash guards (Figure 3). Some users place check valves and flash guards on both ends of the hoses as an added safety feature. These devices prevent the reverse flow of gases through the torch (check valve) or the flame (flash guard) which could cause a fire or tank explosion.

FIGURE 3



- Dispose of broken or damaged tools that cannot be repaired.
- Secure small parts or objects before working on them.
- Store tools properly when not in use.

EXAMPLES: Do not carry tools in your pockets; do not place tools on workbench where they can roll off; protect cutting edges; lightly oil tools before storing; store tools in a dry place

- Stay alert when using tools.

EXAMPLES: Keep fingers away from cutting edge; work away from your body when using cutting tools; pull wrenches toward yourself to prevent smashing your hand if wrench should slip.

- Wear eye protection always.

- General safety rules pertaining to power tools and equipment

NOTE: Power tools may be operated by electricity (ac or dc current), air, combustion engines, or explosive powder.

- Do's

- Always wear eye protection and hard hat when operating a power tool.
- Wear appropriate clothing for job being done.

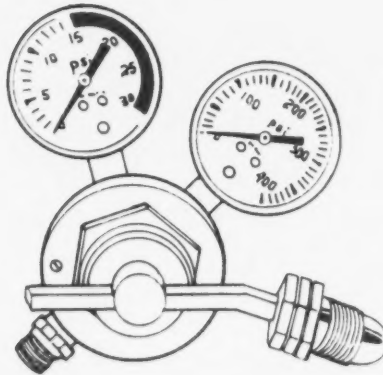
NOTE: Always wear tight-fitting clothing that cannot be caught in the moving tool. Roll up long sleeves, tuck in shirttails, and tie back long hair.

- Assume a safe and comfortable position before using a power tool.



- Regulators (Figure 4) are necessary to reduce the pressure of the released gases. They contain gages and valves that allow the welder to regulate the pressure to the torch.

FIGURE 4



NOTE: GMAW methods use a combination of both a torch and an electric arc. The MIG (Metal Inert Gas) welder is the most popular type of GMAW.

OBJECTIVE 3

From a list of alternatives, choose the proper safety guidelines for the use of welding tools and equipment.

NOTE: These are common guidelines given when using welding tools and equipment. Always follow OSHA rules and regulations.

- Guidelines for safe use and care of hand tools
 - Use the correct tool for the job.
 - Keep cutting tools sharp.
 - Keep tools clean.
 - Inspect tools frequently to make sure they are in good condition.
 - Repair broken or damaged tools promptly.



- Be sure that power tools are properly grounded before using. OSHA requires the use of GFCI protected circuits or other assured grounding method when using AC powered tools and equipment at construction sites.
 - Be sure power tools are disconnected before performing maintenance or changing accessories.
 - Use a power tool only for its intended purpose.
 - Keep fingers, feet, and hair away from blades and other moving parts of a power tool.
 - Keep work area clean at all times.
 - Be familiar with the correct operation and adjustments of a power tool before attempting to use it.
 - Keep a firm grip on the power tool at all times.
 - Use electric extension cords of sufficient size to service the particular power tool you are using.
 - Avoid walking into restricted safety zones marked off around power equipment.
 - Know emergency shut-down procedures for all power equipment.
- Don'ts
- Do not attempt to operate any power tool before being checked out by your instructor on that particular tool.
 - Do not distract others or let anyone distract you while operating a power tool.
 - Do not leave power tools running unattended.
 - Do not use dull or broken tools or accessories.



- Do not use a power tool with guards or safety devices removed.
 - Do not operate an AC powered tool if your hands or feet are wet.
- Safety guidelines when using welding equipment
 - Keep an approved fire extinguisher adjacent to your work area when using any type of welding unit.
 - Wear proper clothing — nylon or rayon material burns easily.
 - Carefully consider the safety of co-workers when welding. Watch for loose tools, welding rods, and hot metals that could fall from elevated areas.
 - DON'T OIL ANY OXYGEN CONNECTIONS.
 - Ensure proper ventilation when welding/cutting.
 - Shut off gasoline operated welding machines before refueling.
 - Refer to OSHA requirements for the proper personal protection equipment. Including eye and face protection, hard hats, leather gloves, leather clothing, and proper foot protection are examples of required equipment.
 - Wear the OSHA-required eye protection. Flying metals and eye burns caused by exposure to intense light (flashes) are common injuries to welders. Burning goggles and welding helmets offer protection by providing shading from intense light. Table 1 is a guide for selecting lens shading requirements.



TABLE 1

LENS-SHADE SELECTOR	
Shade Number	Type of Operation
2	Soldering
3 or 4	Torch brazing
3 or 4 3 or 5 5 or 6	Oxygen cutting 0 to 1 inch 1 to 6 inches 6 inches and over
4 or 5 5 or 6 6 or 8	Gas welding 0 to $\frac{1}{8}$ inch $\frac{1}{8}$ to $\frac{1}{2}$ inch $\frac{1}{2}$ inch and over
9 to 14	Shielded metal-arc welding $\frac{1}{16}$ -, $\frac{3}{4}$ -, $\frac{1}{8}$ -, $\frac{5}{32}$ - inch electrodes
9 to 14	Gas-metal arc welding
9 to 14	Gas-tungsten arc welding (nonferrous) Gas-metal arc welding $\frac{1}{16}$ -, $\frac{3}{32}$ -, $\frac{1}{8}$ -, $\frac{5}{32}$ - inch electrodes
9 to 14	Gas-tungsten arc welding (ferrous), gas-metal arc welding (ferrous) $\frac{1}{16}$ -, $\frac{3}{32}$ -, $\frac{1}{8}$ -, $\frac{5}{32}$ -inch electrodes



OBJECTIVE 4

Choose the word or phrase that correctly complete statements concerning the proper care of power tools and equipment.

- Guidelines for proper care of power tools and equipment



CAUTION: Always disconnect the power supply when performing maintenance or changing accessories on power tools and equipment.

- Inspect tools and accessories regularly.
- Keep tools clean and in good working order.
- Follow manufacturer's maintenance procedures.

NOTE: Failure to read and follow the manufacturer's maintenance procedures can greatly reduce the life of power tools and equipment.

- Protect cutting edges to prevent personnel injuries, prevent rust, and protect them from physical damage.
- Keep all tool accessories such as blades and bits sharp.
- Use the appropriate blade for the arbor size.
- Report any unusual noises, sounds, or vibrations to the instructor or supervisor.
- Store tools in the proper place when not in use.

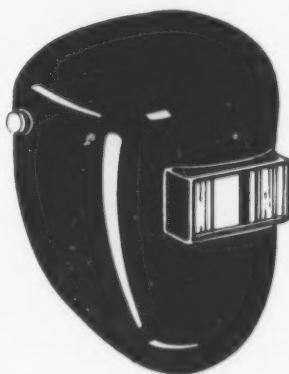


OBJECTIVE 5

Identify welding tools and equipment by their drawings or designated uses. (Assignment Sheet)

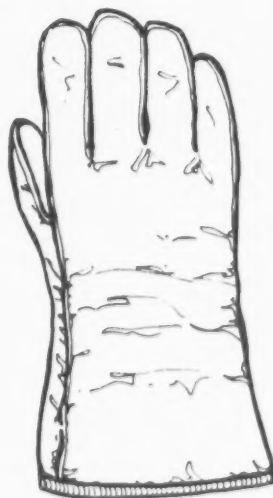
- Personal protection equipment
 - Welding hood

FIGURE 5



- Welding gloves

FIGURE 6

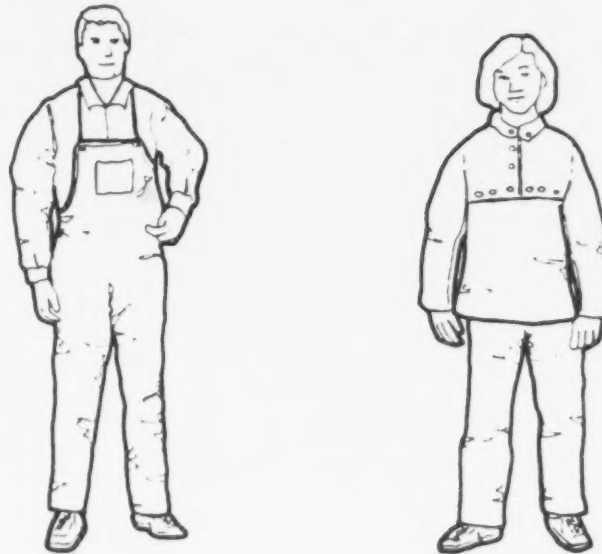


74



— Welding clothing

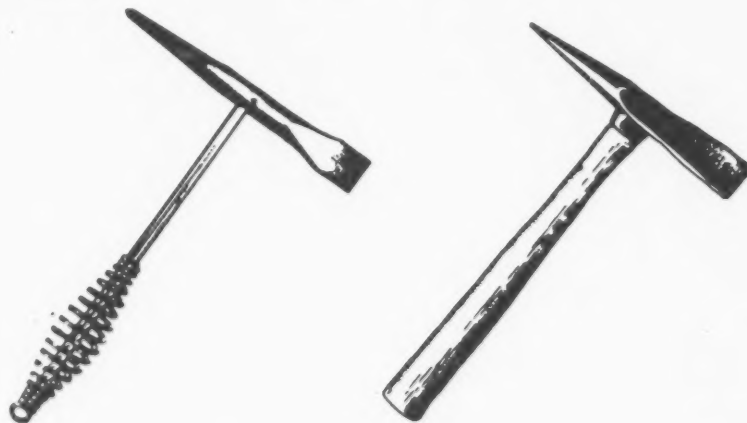
FIGURE 7



- Types of hammers and their characteristics and uses (Figures 8-10)

— Chipping hammer — Used to remove slag and residue left on metals after welding or cutting

FIGURE 8



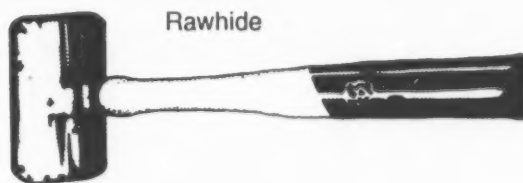
- Fitter's or engineer's hammer — Heavy hammer with two driving heads used to drive wedges under and between materials; comes in weights of 40, 48, and 64 ounces

FIGURE 9



- Mallets — Used where a metal hammer would damage material; made of hickory, rawhide, lead, nylon, rubber, or composition materials

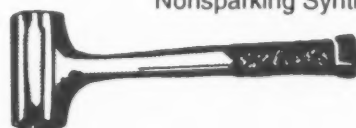
FIGURE 10



Rawhide



Hickory



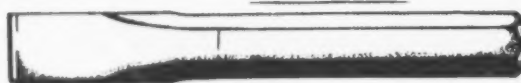
Nonsparking Synthetic

- Types of chisels and punches and their uses (Figures 11-16)

- Cold chisel — Used for cutting metal, rivets, nuts, and bolts

NOTE: Always use ear and eye protection when using chisels and punches.

FIGURE 11



- Cape chisel — Used for cutting keyways in metal

FIGURE 12



- Diamond-point chisel — Used for cutting V-grooves and cleaning out inside corners

FIGURE 13



- Round-nose chisel — Used for cutting U-shaped grooves in metal

FIGURE 14



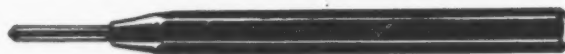
- Drift punch — Used for driving out straight or tapered pins

FIGURE 15



- Center punch — Used to make puncture marks, to locate centers of holes, or to establish work points or center lines on materials

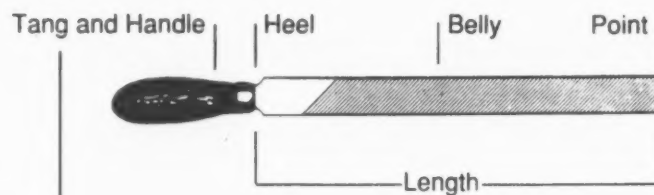
FIGURE 16



- Files, their uses, basic shapes, and cuts (Figures 17-21)

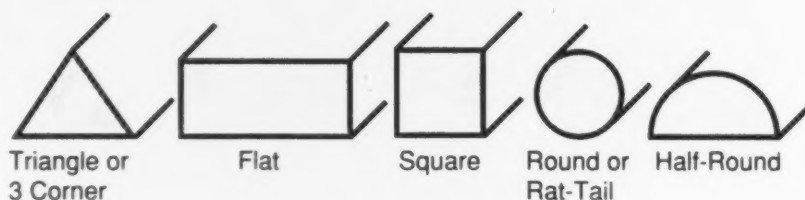
- Files — Used manually to remove metal stock

FIGURE 17



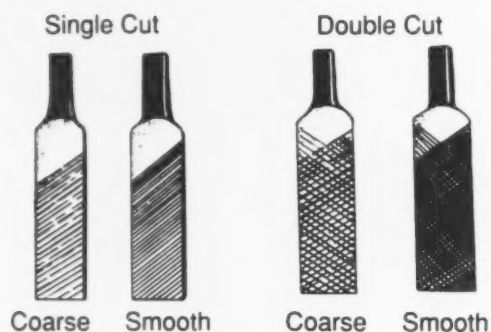
- Basic shapes of files — Triangular, flat, square, round or rat-tail, and half-round to provide a shape to match the job needed

FIGURE 18



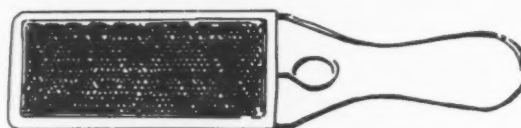
- Basic file cuts — Range from single-cut coarse to double-cut smooth to provide textures that produce specific finishes

FIGURE 19



- Card file — Used to clean file

FIGURE 20



- File handle — Used to cover the tang (handle) of a file and to protect against injury; a file should not be used without a handle

FIGURE 21



- Wire brushes and their types and uses (Figure 22)
 - Uses — For cleaning a weld area before or after welding; also used to clean rust, corrosion, and paint from metal
 - Types — Steel wire bristles or stainless steel bristles with shoe handles or bent handles

FIGURE 22



- Holding and anchoring tools and their characteristics and uses (Figures 23-26)
 - Vise-grip clamps — Pliers-type devices used to hold materials until they can be tacked in place; adjustable to almost any metal gauge and handy to work with because they are easily attached and removed.

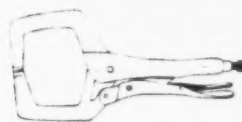
FIGURE 23



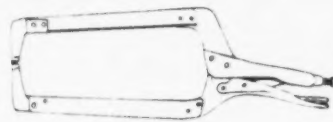
Curved Jaw

Straight Jaw

Sheet Metal Tool



C-Clamp



Long-Reach
C-Clamp



Welding Clamp



Chain Clamp

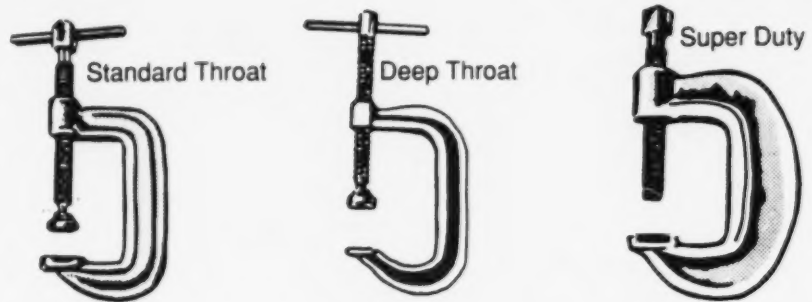
- Bar clamps — Adjustable vise-like devices used to hold materials together until they can be joined by other means; will hold longer and wider materials than a vise

FIGURE 24



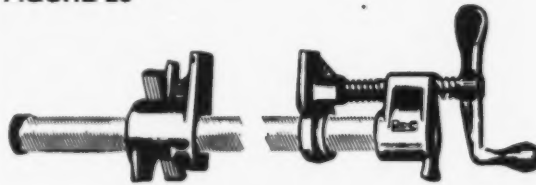
- C-clamps — Used to hold two or more pieces of material together until they can be tacked or joined together by other means

FIGURE 25



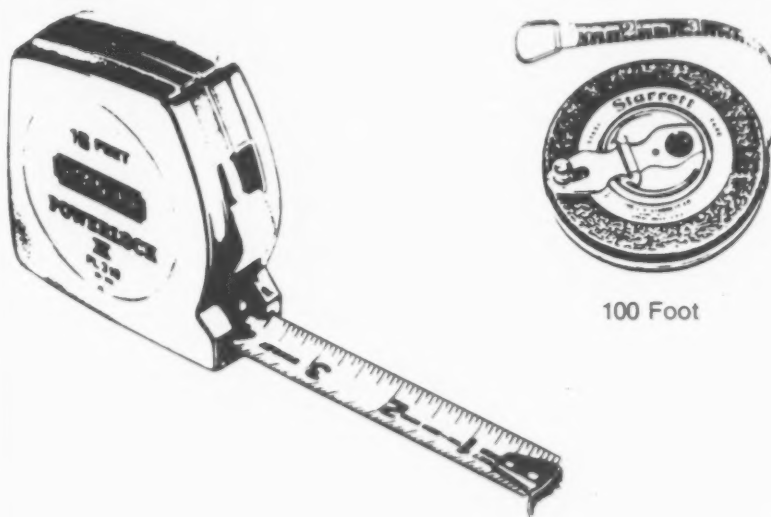
- Pipe clamps

FIGURE 26



- Measuring instruments and their characteristics and uses (Figures 27)
- Steel tape — Used to measure gauges, set lines, holes, workpoints, and layout work, and for squaring

FIGURE 27



- Wing divider — Used to construct small circles and arcs and to transfer measurements

FIGURE 28



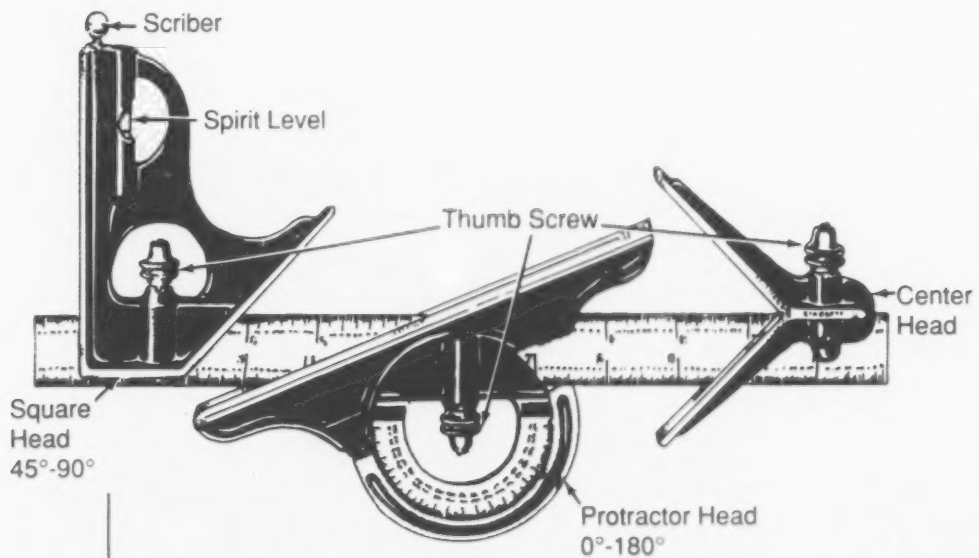
- Types of squares and their characteristics and uses (Figures 29-31)
 - Framing square — Used primarily by welders to check trueness of flanges and angles; used for setting and checking bevel squares and for layout work

FIGURE 29



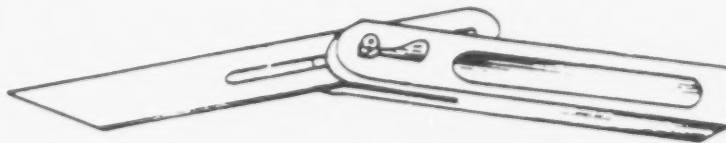
- Combination square — Used to square detail material; square head is used for 45° to 90° angles, protractor head is used to read angles from 0° to 180° , and center head is used to find the center of round materials

FIGURE 30



- Bevel square — Used to lay out bevel lines or check materials cut on a bevel; can be adjusted to all angles

FIGURE 31



- Types of hand levels and their characteristics and uses (Figures 32-33)
 - Spirit level — Used to check level of surfaces, plumb and align related members vertically or at a 45° angle

FIGURE 32



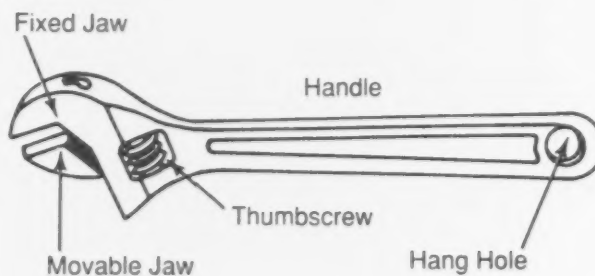
- Torpedo level — Used to check level, grade, or plumb of short members, such as stair risers and treads

FIGURE 33



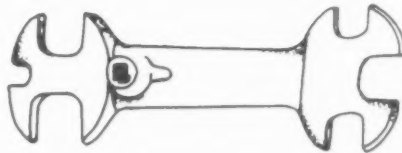
- Types of wrenches and their uses (Figures 34-36)
 - Adjustable wrench — Used to tighten or loosen different sizes of nuts and bolts and other fittings

FIGURE 34



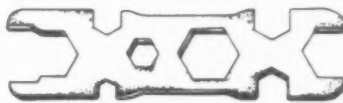
- Cylinder wrench — Used specifically for tightening or loosening cylinder connections on oxyacetylene equipment because adjustable wrenches can easily damage the brass fittings.

FIGURE 35



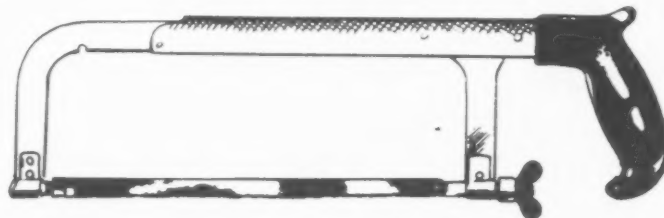
- Torch wrench — Used specifically for tightening or loosening torch connections when the use of adjustable wrenches or pliers might damage brass fittings

FIGURE 36



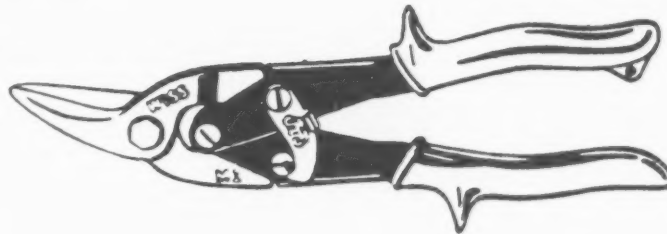
- Types of cutting and shaping tools and their uses (Figures 37-40)
 - Hacksaw — Used to manually cut or separate metal

FIGURE 37



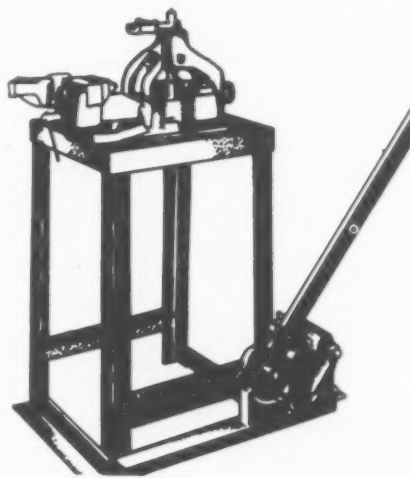
- Straight-cut snips — Used to cut straight lines or curves on light-gauge metal; also available in left or right cuts

FIGURE 38



- Angle iron cutter, notcher, and bender — Used to cut, notch, and bend angle iron

FIGURE 39

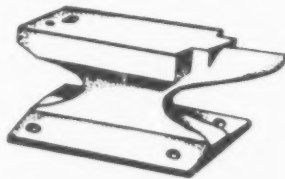


85



- Anvil — Iron or steel block with both flat and curved surfaces for shaping metal that is hammered or peened against it; it sometimes has a tapered round end for curving metal strapping and other materials

FIGURE 40



- Portable power tools used by welders (Figures 41-42)

- Portable band saw

- Portable hand grinder

FIGURE 41

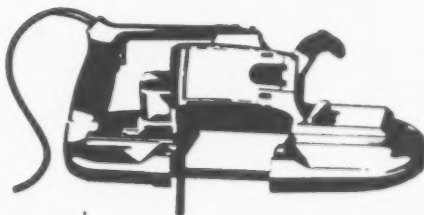
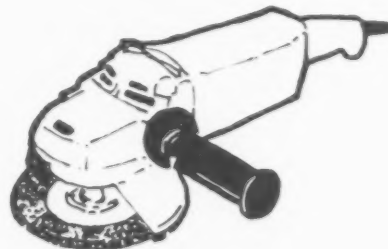


FIGURE 42



NOTE: Severe injuries have resulted from using grinders without a safety shield in place, using blades that are under rated (RPM), or by wearing inappropriate clothing.

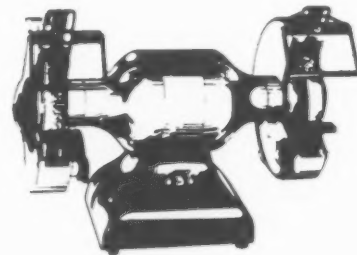
- Stationary power tools used by welders (Figures 43-47)
 - Grinders

FIGURE 43

Pedestal



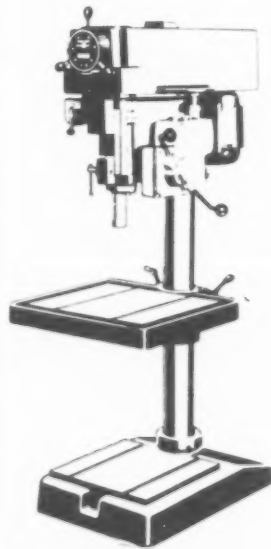
Bench



NOTE: The most common injuries in the use of grinders result from users not wearing eye protection or from using under rated grinder stones (RPM).

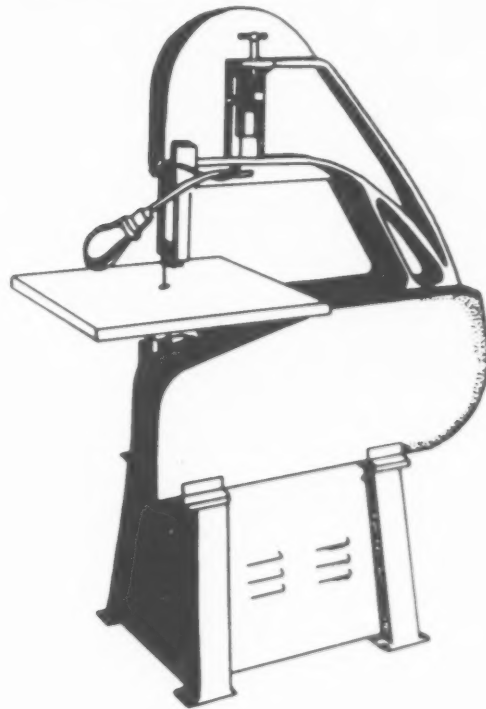
— Drill press

FIGURE 44



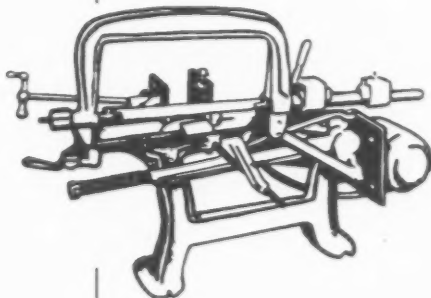
— Vertical band saw

FIGURE 45



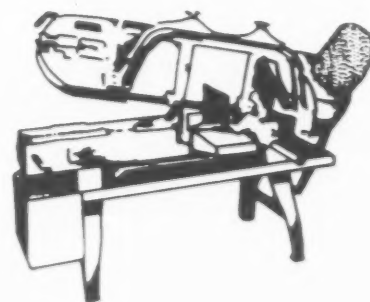
— Power hacksaw

FIGURE 46

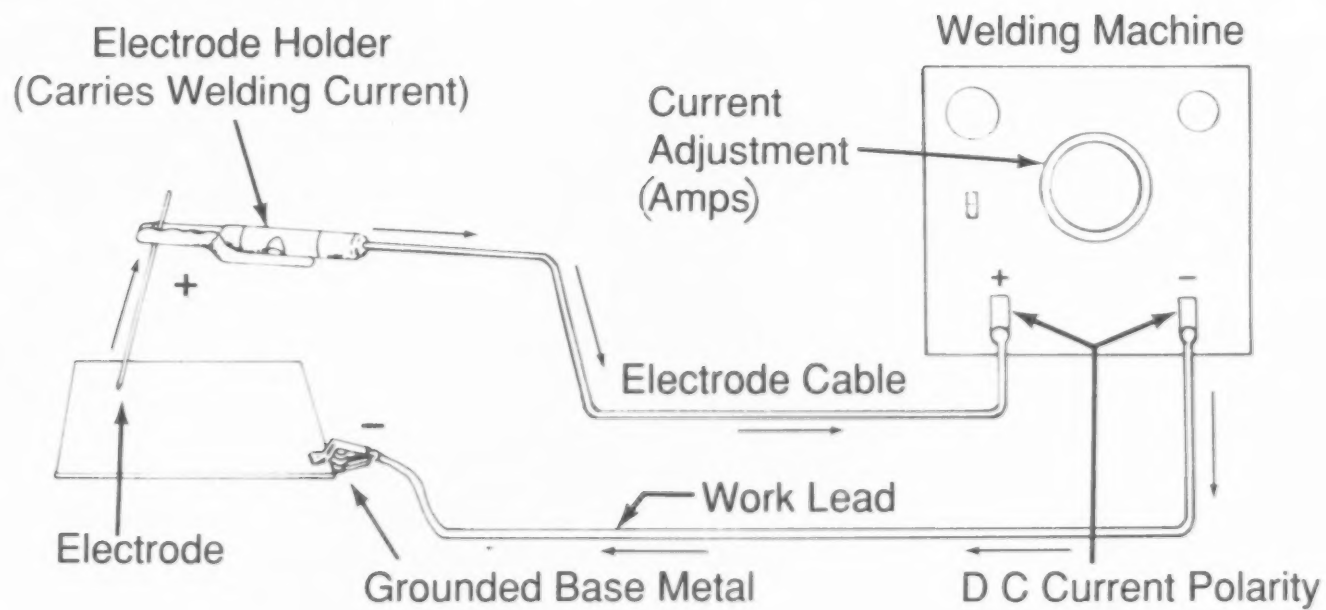


— Horizontal band saw
(metal cutting)

FIGURE 47



Arc Welding Unit



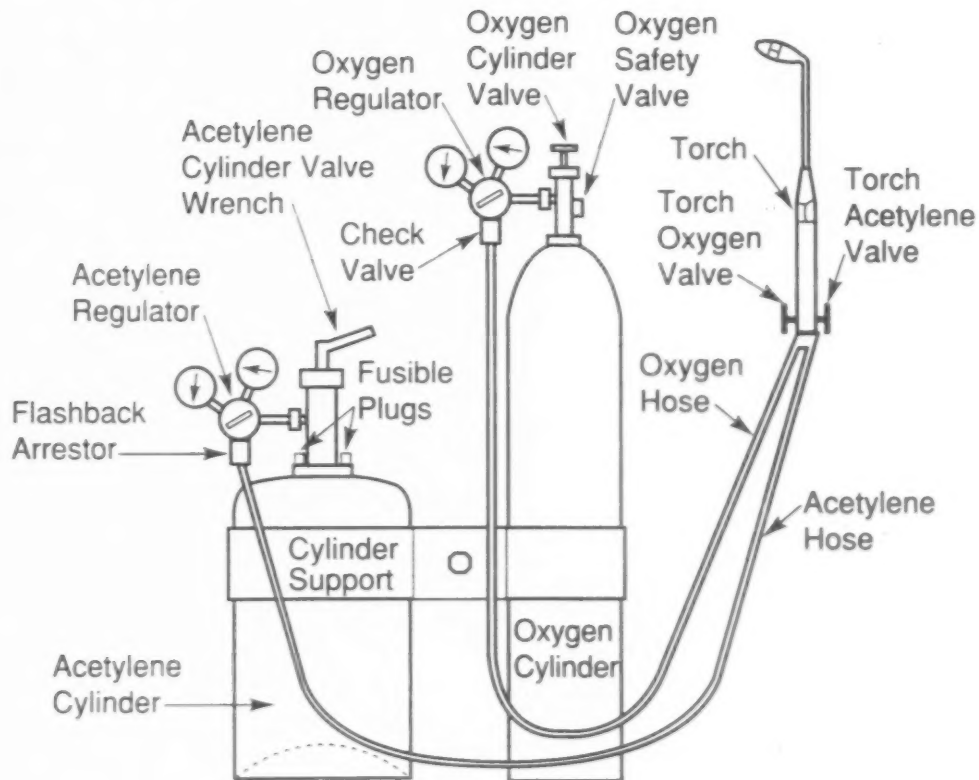
92

93

TM 1



Oxyacetylene Welding Unit



94



**ASSIGNMENT
SHEET**

WELDING TOOLS AND EQUIPMENT

A 2

Name _____ Score _____

OBJECTIVE 5

Given a list of welding tools and equipment, match them to their drawings.

INTRODUCTION

As a welder, you must be able to identify common tools and equipment used in construction welding.



Functional Reading

- Use content area vocabulary

95



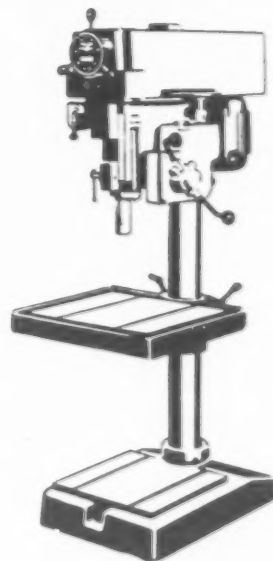
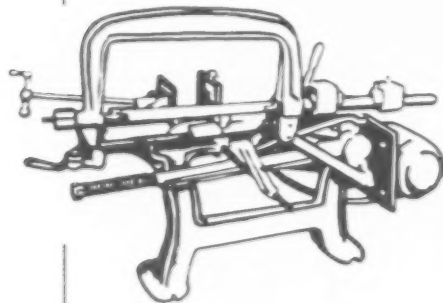
INSTRUCTIONS

Part A

Match the drawings by writing the title in the space provided.

Rawhide mallet
Torch wrench
Rat-tail file
Spirit level
Drift punch
Curved jaw vise-grips
Bar clamps
Cape chisel
Steel tape
Anvil
Bench grinder
Portable hand grinder
Power hacksaw

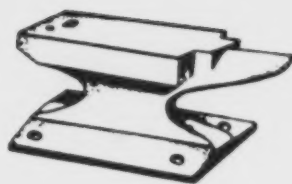
Wire brush
Wing divider
Chipping hammer
Super duty C-clamp
Center punch
Straight-cut snips
Cold chisel
Card file
Cylinder wrench
Combination square
Portable band saw
Drill press



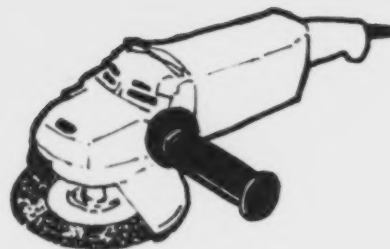
1. _____

2. _____

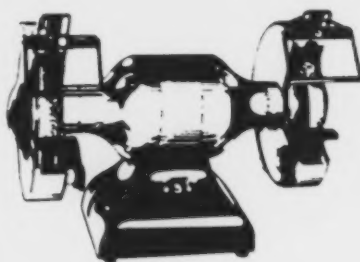




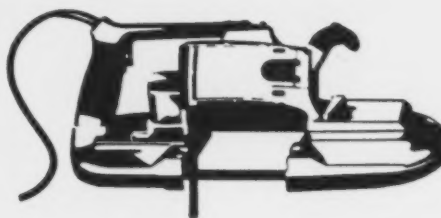
3. _____



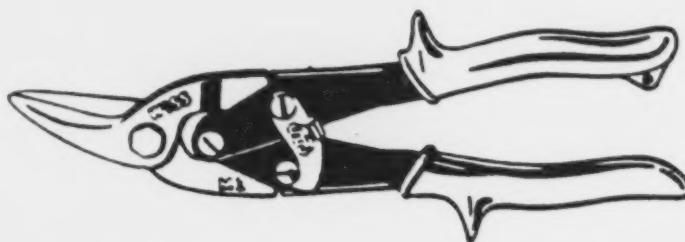
4. _____



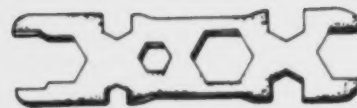
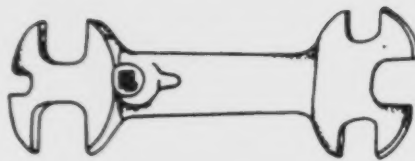
5. _____



6. _____

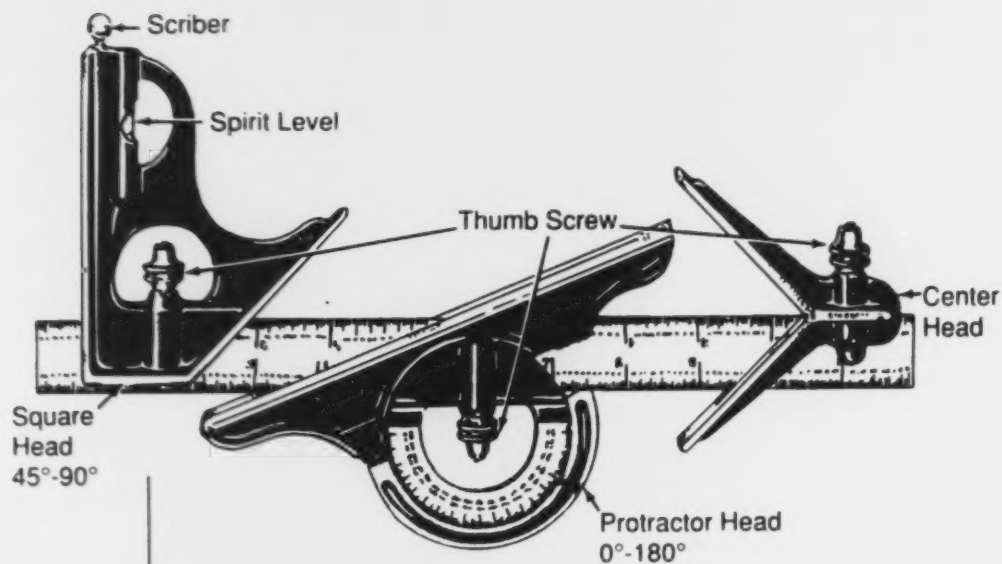


7. _____



8. _____

9. _____



10. _____



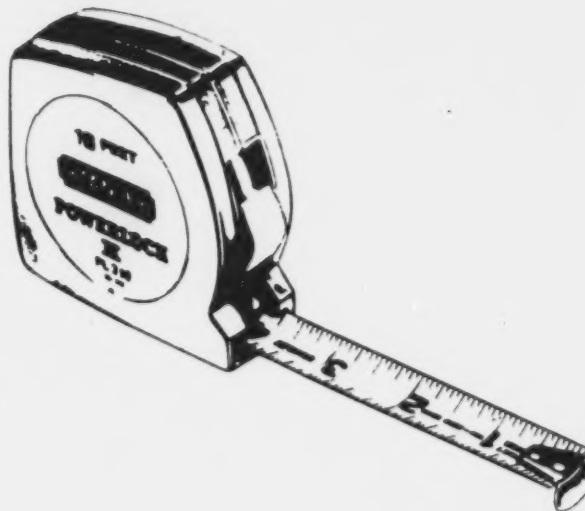
11. _____



12. _____



13. _____



14. _____



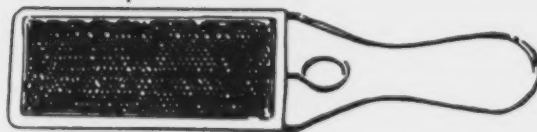
15. _____



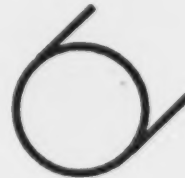
16. _____



17. _____



18. _____



19. _____



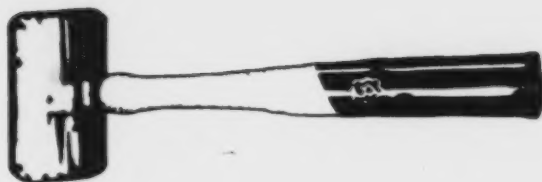
20. _____



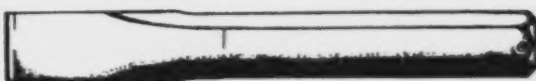
21. _____

100

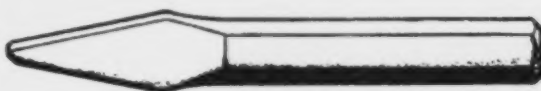




22. _____



23. _____



24. _____



25. _____



Part B

- _____ 1. Tool used for cleaning a weld area before or after welding; also used to clean rust, corrosion, and paint from metal
 - a. tang
 - b. card file
 - c. wire brush
 - d. double-cut file
- _____ 2. Tool used to remove slag and residue left on metals after welding or cutting
 - a. chipping hammer
 - b. hickory mallet
 - c. cold chisel
 - d. fitter's hammer
- _____ 3. Tool used to square detail material; measure 40°-90° angles, read angles from 0°-180°, and find the center of round materials
 - a. framing square
 - b. steel tape
 - c. wing divider
 - d. combination square
- _____ 4. Measuring tool used to check trueness of flanges and angles, for setting, and checking bevel squares and for layout work
 - a. framing square
 - b. steel tape
 - c. combination square
 - d. bevel square
- _____ 5. Tool with flat and curved surfaces for shaping metal that is hammered or peened against it
 - a. ball peen plate
 - b. drill press
 - c. anvil
 - d. mallet



- _____ 6. Tool used to check level, grade, or plumb of short members, such as stair riser and treads
- a. combination square
 - b. torpedo level
 - c. spirit level
 - d. bevel square
- _____ 7. Heavy tool with two driving heads used to drive wedges under and between materials
- a. mallet
 - b. chipping hammer
 - c. fitter's or engineer's hammer
 - d. driver
- _____ 8. Pliers-type devices used to hold materials until they can be tacked in place
- a. bar clamps
 - b. C-clamps
 - c. vise grip clamps
 - d. crescent wrenches
- _____ 9. Tool used for cutting keyways in metal
- a. cape chisel
 - b. diamond-point chisel
 - c. center punch
 - d. drift punch
- _____ 10. Tool used to tighten or loosen different sizes of nuts, bolts, and fittings
- a. vice grip clamps
 - b. adjustable wrench
 - c. torch wrench
 - d. combination wrench



_____ 11. Tool used for cutting metal, rivets, nuts, and bolts

- a. round-nose chisel
- b. cold chisel
- c. chipping hammer
- d. center punch

_____ 12. Tool used to construct small circles and arcs and to transfer measurements

- a. protractor
- b. framing square
- c. rounder
- d. wing divider

_____ 13. Tool used to manually remove metal stock

- a. drift punch
- b. nonsparking synthetic mallet
- c. cape chisel
- d. triangle file

_____ 14. Tool used for driving out straight or tapered pins

- a. chipping hammer
- b. drift punch
- c. card file
- d. round-nose chisel

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**ASSIGNMENT
ANSWERS**

WELDING TOOLS AND EQUIPMENT

A 2

**ASSIGNMENT
SHEET 1**

Part A

- | | |
|--------------------------|---------------------------|
| 1. Power hacksaw | 14. Steel tape |
| 2. Drill press | 15. Bar clamp |
| 3. Anvil | 16. Curved jaw vise grips |
| 4. Portable hand grinder | 17. Wire brush |
| 5. Bench grinder | 18. Card file |
| 6. Portable band saw | 19. Rat-tail file |
| 7. Straight-cut snips | 20. Drift punch |
| 8. Cylinder wrench | 21. Center punch |
| 9. Torch wrench | 22. Rawhide mallet |
| 10. Combination square | 23. Cold chisel |
| 11. Spirit level | 24. Cape chisel |
| 12. Wing divider | 25. Chipping hammer |
| 13. Super duty C-clamp | |

Part B

- | | |
|------|-------|
| 1. c | 8. c |
| 2. a | 9. a |
| 3. d | 10. c |
| 4. a | 11. b |
| 5. c | 12. d |
| 6. b | 13. d |
| 7. c | 14. b |



**WRITTEN
TEST**

WELDING TOOLS AND EQUIPMENT

A 2

Name _____ Score _____

OBJECTIVE 1

Given a list of terms and abbreviations associated with welding tools and equipment, match them to their correct definitions. Write in the letter that corresponds with the most correct answer.

- _____ 1. A groove cut into a shaft to accept a key is called a
- a. keyway
 - b. notch
 - c. lock
 - d. groove inset
- _____ 2. The flow of current across a narrow gap, usually from the tip of an electrode to a base metal is known as a/an
- a. flash point
 - b. flame
 - c. fusion spark
 - d. arc
- _____ 3. AWS is an abbreviation for the
- a. American Welding Society
 - b. Amateur Welding Society
 - c. Average Welding Sizes
 - d. American Welding School
- _____ 4. Special circuits used to protect workers from electrical shock when using AC powered tools and equipment are
- a. OSHA circuits
 - b. GFCI circuits
 - c. AWS circuits
 - d. GMAW circuits

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- _____ 5. The abbreviation psi is used to represent
- a. pressure source-in
 - b. pounds per source-in
 - c. pounds per square inch
 - d. pressure stored inside
- _____ 6. The process of temporarily welding parts in alignment until the final welds are made is known as
- a. clamping
 - b. tacking
 - c. bonding
 - d. fusing
- _____ 7. The process of liquefying by melting is called
- a. fusion
 - b. bonding
 - c. expansion
 - d. module jointing
- _____ 8. The nonmetallic porous material trapped in the weld metal or between the weld metal and base metal is known as
- a. alloys
 - b. flux
 - c. slag
 - d. crust
- _____ 9. OSHA is
- a. a metal alloy used in electrodes
 - b. federal legislation designed to ensure safe and sanitary working conditions
 - c. a federal agency that ensures minimum wage laws are enforced
 - d. a government agency established to set standards for construction welding

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- _____ 10. The joining of two or more pieces of metal by the fusion process is called
- a. arc welding
 - b. cold fusion
 - c. electron bonding
 - d. AWS
- _____ 11. Oxyacetylene welding methods include
- a. arc welding and soldering
 - b. GFCI welding and brazing
 - c. SMAW and GMAW
 - d. soldering and brazing
- _____ 12. Arc welding is also known as
- a. gas welding
 - b. GFCI welding
 - c. SMAW
 - d. soldering and brazing

OBJECTIVE 2

State the purpose of the major components of common equipment used in electrical arc and oxyacetylene welding.

- _____ 1. Which of the following components of an electrical arc welder produces the electric current?
- a. Electrode holder
 - b. Electrode
 - c. Welding machine
 - d. Cables
- _____ 2. When using an electrical arc welder, heat generated by the electrical arc
- a. melts both the electrode and the base metal
 - b. melts the electrode only
 - c. melts the base metal only
 - d. fuses the base metals without melting the electrode

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- _____ 3. The current (amperage) adjustment of a welding machine is used to
- a. set the voltage rating
 - b. compensate for an open current path
 - c. reverse the polarity of the leads
 - d. set the required amount of heat for fusion
- _____ 4. At the construction site, oxyacetylene welding units are most commonly used to cut and
- a. arc weld heavy metals
 - b. solder or braze metals
 - c. heat porous materials
 - d. weld steel plates
- _____ 5. In oxyacetylene welding units, the cylinders
- a. store propane and oxygen
 - b. store acetylene gas and oxygen
 - c. contain a flame retardant in the event of a fire
 - d. are only used for metal cutting
- _____ 6. In an oxyacetylene welding unit, a flash guard must be installed to
- a. prevent fire or tank explosions
 - b. reduce welder eye injuries
 - c. increase the temperature of the flame
 - d. reduce heat in the area where welding
- _____ 7. In an oxyacetylene welding unit, the torch is used to
- a. fuel the flame
 - b. control and concentrate the flame
 - c. create an electrical arc
 - d. prevent the gases from reversing

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- _____ 8. The components that reduce the pressure of the released gases are called
- a. check valves
 - b. torches
 - c. regulators
 - d. cylinders
- _____ 9. When welding, ensure there is
- a. proper ventilation
 - b. a fire extinguisher adjacent to work area
 - c. both a and b are correct
 - d. a fire extinguisher somewhere on the construction site
- _____ 10. When using an electric extension cord, it must be
- a. coiled and placed away from you
 - b. of sufficient size to service the tool being used
 - c. ungrounded
 - d. red in color and have a grounding lug

OBJECTIVE 3

From a list of alternatives, choose the proper safety guidelines for the use of welding tools and equipment.

- _____ 1. When preparing to operate *any* power tool, you must first
- a. be checked out by your instructor
 - b. wear a face shield
 - c. remove safety devices
 - d. be certified on that power tool
- _____ 2. When operating power tools, you are required to
- a. wear leather gloves
 - b. use an extension cord with the ground lug removed
 - c. wear eye protection and a hard hat
 - d. both b and c are correct

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- _____ 3. When using a welding unit, you must
- a. be assisted by a co-worker to ensure safety
 - b. refer to OSHA regulations for the proper size and type of electrodes
 - c. wear goggles, a shield, and a helmet
 - d. keep an approved fire extinguisher adjacent to your work area
- _____ 4. If unsure of the proper personnel protection equipment to wear while welding, you can reference
- a. FDA regulations
 - b. co-workers
 - c. HED guidelines
 - d. OSHA regulations
- _____ 5. When using ac powered tools and equipment at construction sites, OSHA requires
- a. two workers to be present at all times
 - b. the use of GFCI protected circuits
 - c. the grounding lug for all extension cords be removed
 - d. all the above
- _____ 6. When performing maintenance or changing accessories on a power tool, you must
- a. disconnect it first
 - b. consult your supervisor
 - c. refer to federal regulations
 - d. ask a co-worker to assist you
- _____ 7. When welding, you are required to wear eye protection to prevent
- a. escaping gases from heated metals
 - b. exposure to unburned gases
 - c. eye injuries from heated air
 - d. eye injuries from flying metals and the intense light

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- _____ 8. When your hands or feet are wet, you should
- a. not operate AC-powered tools or equipment
 - b. not use a hand tool
 - c. not be concerned in operating any type of ac powered tool
 - d. refer to the manufacturer's instructions when using an AC-powered tool

OBJECTIVE 4

Choose the word or phrase that correctly complete statements concerning the proper care of welding tools and equipment.

- _____ 1. Inspect tools and accessories
- a. seldom
 - b. monthly
 - c. yearly
 - d. regularly
- _____ 2. Store tools in their proper place when
- a. not in use
 - b. they are new
 - c. they have blades
 - d. are ac powered
- _____ 3. When you perform maintenance on power tools or equipment, you must
- a. follow the manufacturer's procedures
 - b. remove the grounding lug from its power cord
 - c. make a list of unusual noises
 - d. interchange blades of various tools
- _____ 4. Cutting edges of tools must be protected to prevent
- a. injuries to personnel
 - b. rust
 - c. physical damage
 - d. all the above

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- _____ 5. If a power tool makes unusual noises, sounds, or vibrations
- a. use it as long as possible
 - b. tell your co-worker
 - c. report it to your instructor or supervisor
 - d. tag it and put it back into storage

NOTE: Objective 5 is evaluated on the assignment sheet in this unit. If you have not completed this component, see your instructor.



WRITTEN TEST ANSWERS	WELDING TOOLS AND EQUIPMENT	A 2
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OBJECTIVE 1

- | | |
|------|-------|
| 1. a | 7. a |
| 2. d | 8. c |
| 3. d | 9. b |
| 4. b | 10. a |
| 5. c | 11. d |
| 6. b | 12. c |

OBJECTIVE 2

- | | |
|------|-------|
| 1. c | 6. a |
| 2. a | 7. b |
| 3. d | 8. c |
| 4. b | 9. c |
| 5. b | 10. b |

OBJECTIVE 3

- | | |
|------|------|
| 1. a | 5. b |
| 2. c | 6. a |
| 3. d | 7. d |
| 4. d | 8. a |

OBJECTIVE 4

- | | |
|------|------|
| 1. d | 4. d |
| 2. a | 5. c |
| 3. a | |



CIMC TEST CODE SHEET

VOCATIONAL PROGRAM (BOOK TITLE) INTRODUCTION TO CONSTRUCTION WELDING

UNIT NUMBER AND TITLE A2 – WELDING TOOLS AND EQUIPMENT

TOTAL NUMBER OF TEST QUESTIONS 35

TOTAL NUMBER OF BASIC SKILL QUESTIONS 8

OBJECTIVE NUMBER	TEST QUESTION NUMBER(S)	BASIC SKILL CODE(S)
1	1, 3, 4, 6, 11, 12	X
1	2, 5, 7, 8, 10	S
1	9	U
2	1, 2, 4-10	X
2	3	S
3	1-3, 5-8	X
3	4	U
4	1-5	X

OBJECTIVE SHEET	APPLIED SKILLS A 3
INTRODUCTION	Construction welding consists of such duties as cutting, soldering, brazing, and welding metals. These duties require the safe and efficient use of specialized hand tools and welding equipment. During this unit, you will be using the safety guidelines and personal protection equipment as you practice cutting and bonding metals.
PREREQUISITE	<i>Fundamentals of Construction</i>
UNIT OBJECTIVE	After completing this unit, the student will be able to safely cut and bond metals. The student will demonstrate these competencies by completing the assignment sheets, job sheets, and written test with a minimum of 85 percent accuracy.
SPECIFIC OBJECTIVES	After completing this unit, the student will be able to show the ability to: 1. Given a list of terms associated with welding skills, match them to their correct definitions. 2. Select the proper phrase that completes statements that define the process of cutting metal with an oxyacetylene torch. 3. Choose the proper phrase that completes statements required to arc weld metals. 4. Given drawings, label them with the proper weld types. (Assignment Sheet 1) 5. Given drawings, identify welding symbols. (Assignment Sheet 2) 6. Prepare an oxyacetylene torch for cutting metal. (Job Sheet 1) 7. Use an oxyacetylene torch to cut mild steel. (Job Sheet 2)



8. Use an electric arc welder to start, stop, and restart a bead. (Job Sheet 3)
9. Use an electric arc welder to construct a pad weld. (Job Sheet 4)
10. Use an electric arc welder to construct a butt weld. (Job Sheet 5)



SUGGESTED ACTIVITIES	APPLIED SKILLS A 3
PREPARATION	• Review unit and plan presentation. • Order or obtain materials to supplement unit. • Introduce unit.
DELIVERY	Objective 1: Given a list of terms associated with welding skills, match them to their correct definitions. • Use the Information Sheet to discuss cutting and welding terms used in construction. Objective 2: Select the proper phrase that completes statements that define the process of cutting metal with an oxyacetylene torch. • Describe the personal protection equipment required to use an oxyacetylene torch. • Show the film titled <i>Flame Cutting</i>. • Show AGC film titled <i>Fire Extinguisher Operation</i>. • Emphasize procedures to recover from backfires and flashbacks. Objective 3: Choose the proper phrase that completes statements required to arc weld metals. • Show the film titled <i>Arc Welding Methods</i>. • Emphasize the safety guidelines required in arc welding. • Obtain catalogs that discuss arc welding equipment and procedures. • Show students samples of properly welded joints.



APPLICATION

- Describe the most common cause of weld failures.

Objective 4: Given drawings, label them with the proper weld types. (Assignment Sheet 1)

Objective 5: Given drawings, identify welding symbols.
(Assignment Sheet 2)

- Use Transparencies 1-6 to show examples of welding symbols.

Objective 6: Prepare an oxyacetylene torch for cutting metal.
(Job Sheet 1)

Objective 7: Use an oxyacetylene torch to cut mild steel. (Job Sheet 2)

Objective 8: Use an electric arc welder to start, stop, and restart a bead. (Job Sheet 3)

Objective 9: Use an electric arc welder to construct a pad weld. (Job Sheet 4)

Objective 10: Use an electric arc welder to construct a butt weld. (Job Sheet 5)

- Allow students to practice the procedures in the job sheets.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.



**SUGGESTED
RESOURCES**

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

NOTE: The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

Electronic Media

- *Arc Welding Methods.* 30 minutes, color, Association Films, 1986. Available from Association Films, 600 Grand Avenue, Richfield, New Jersey, 07657.

NOTE: This film explain major arc welding processes, required equipment, and progress made in the field.

- *Fire Extinguisher Operation.* 5 minutes, color, VHS, The Associated General Contractors of America, 1957 E. Street N.W., Washington, D.C.



UNIT
REFERENCES

- *Flame Cutting*. Color, 20 minutes, MacMillian Films, 1990. Available from MacMillian films, 34 MacQuesten Parkway South, Mount Vernon, New York 10550, 914/664-5051.

NOTE: This film provides step-by-step instructions for making straight-line cuts, cutting irregular shapes, beveling plate edges, and making circle cuts. It gives excellent instructions on freehand cutting with an oxyacetylene cutting torch.

- Althouse, Andrew P., Carol H. Turnquist, and William A. Bowditch. *Modern Welding*. Homewood, Illinois: Goodheart-Willcox Company, 1992.
- Jefferson, T.B. *The Welding Encyclopedia*. Morton Grove, Illinois: Monticello Books, 1980.
- *Symbols for Welding and Nondestructive Testing*. Miami, Florida: American Welding Society, Inc., 1989.
- Willey, Al. *Commercial Carpentry*. Stillwater, Oklahoma: Oklahoma Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1993.



INFORMATION SHEET	APPLIED SKILLS A 3
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OBJECTIVE 1

Given a list of terms associated with welding skills, match them to their correct definitions.

- **acetylene** — colorless, gaseous hydrocarbon used in cutting and welding
- **NOTE:** Other gases are also used in cutting.
- **backfire** — when using an oxyacetylene torch, an occurrence in which the flame burns momentarily back into tip; then a loud snap or pop is emitted from the torch and the flame either goes out or continues to burn in a normal manner
- **bevel** — angular cut made on the vertical edge of the base metal to allow better weld penetration
- **butt joint** — weld between two metal joints on the same plane
- **crater** — depression at the termination of a weld
- **fillet joint** — a weld made in the corner or at the angle formed by two pieces of metal joining at or near right angles to one another
- **flashback** — when using an oxyacetylene torch, an occurrence in which the flame disappears inside torch body; at the same time, a squealing noise occurs and smoke and/or sparks are emitted from the torch tip
- **flint lighter** — striker used to ignite the torch
- **flux** — coating on the outside of electrode; chemical used to promote fusion during the welding process
- **molten** — liquified by heat
- **oxyacetylene cutting** — flame cutting of metal in which the preheating of the metal is accomplished with a flame produced by an oxyacetylene torch



- **oxygen** — a colorless, odorless, and tasteless gas; used in combination with other substances in cutting and welding
- **pass** — single longitudinal progression of a welding operation along a joint or weld deposit
- **penetration** — distance from the original surface of the base metal to that point at which fusion ceases
- **polarity** — condition of being positive (+) or negative (-), as the ends of a magnet or electrical mechanism
- **puddle** — portion of a weld that is molten at the place heat is applied
- **rippled** — material that is lightly ruffled or covered with small waves
- **slag** — metal that melts away during the oxyacetylene cutting process
- **slag box** — metal container with a layer of water or sand to catch hot material
- **toxic** — poisonous material or substance that is harmful to workers
- **wire core** — metal center of electrode

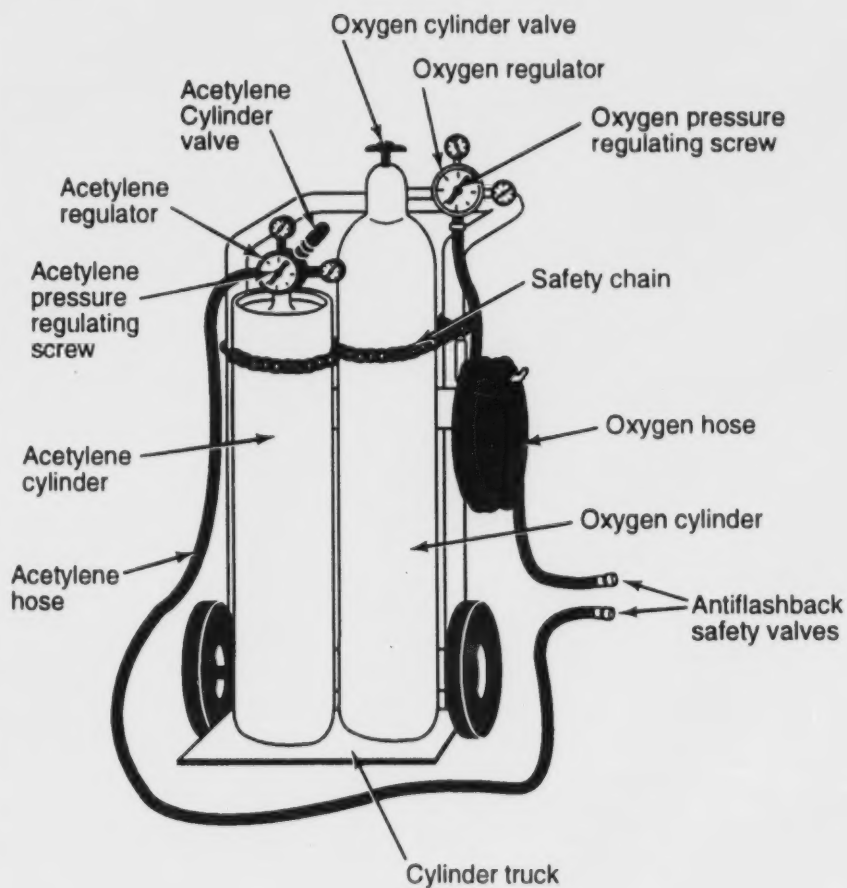
OBJECTIVE 2

Select the proper phrase that completes statements that define the process of cutting metal with an oxyacetylene torch.

- Cutting metal with an oxyacetylene torch
 - Observe OSHA safety rules and regulations
 - Set up oxyacetylene unit. (Figure 1)



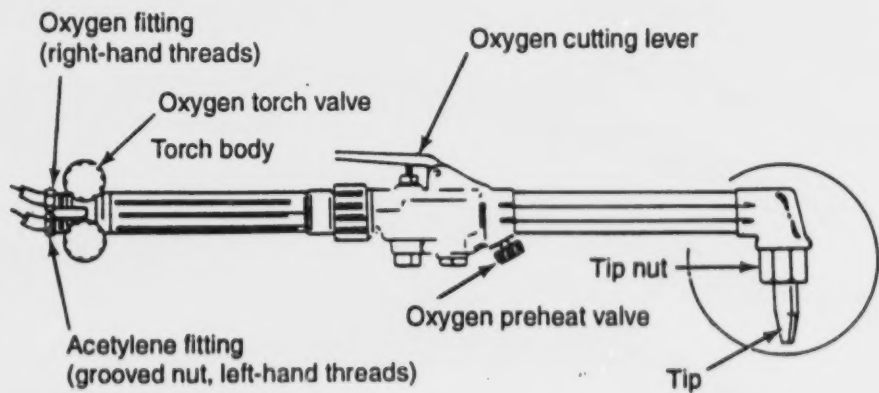
FIGURE 1



- Attach torch to hoses.
- Turn torch valves off.
- Adjust the acetylene and oxygen pressures using the valves and regulators on the cylinder.

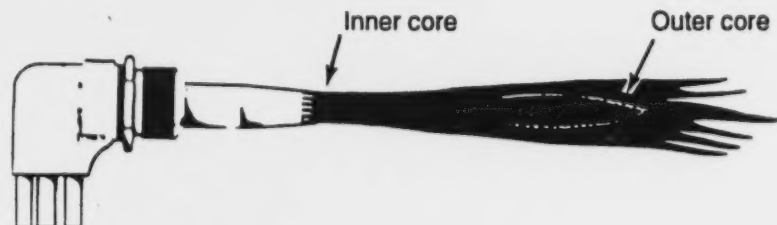
- Ignite torch (Figure 2) by opening the acetylene valve and using a flint lighter.

FIGURE 2



- Adjust the oxygen and acetylene torch valves to achieve a neutral flame. (Figure 3)

FIGURE 3



- As a safety precaution, watch the torch tip for possible flashback or backfire. Should a flashback occur, follow the recovery steps.
 1. Close oxygen preheat valve.
 2. Close oxygen torch valve.

3. Close acetylene torch valve.
4. Release pressure on oxygen pressure-regulating screw.
5. Release pressure on acetylene pressure-regulating screw.
6. Examine acetylene unit.
7. Reset regulator pressures.
8. Relight torch.

NOTE: If heavy smoke comes out of the torch tip and the torch body becomes hot, the flashback has probably traveled past the mixing chamber into the hose. In this case, shut off the oxygen and acetylene cylinders, and then notify the supervisor.

— Backfire causes

NOTE: The conditions listed below should be carefully checked to control backfire.

1. Not enough acetylene or oxygen pressure for the tip size used
2. Loose cutting tip
3. Dirty tip

NOTE: Tip may have deposits or metal particles inside orifice. These deposits may overheat and act as ignitors.

4. Overheating of cutting tip
5. Bad O-ring in torch body

— Pre-heat metal



- Cut metal

NOTE: Review these procedures to prepare to complete job sheets.

OBJECTIVE 3

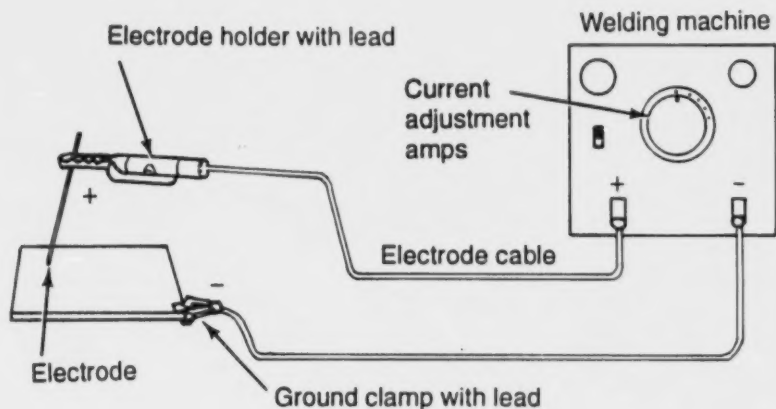
Choose the proper phrase that completes statements required to arc weld metals.

- The arc welding process consists of
 - Setting up the electric arc welder
 - Using required personal protection equipment
 - Selecting an electrode
 - Setting the welding machine's amperage dial
 - Striking a test bead
 - Examining the test bead
 - Continuing to weld
 - Inspecting and cleaning the bead
- Setting up the electric arc welder
 - With the welding machine's power switch turned off, plug the AC cord into an outlet.



- Attach ground lead (–) from the welding machine terminal to the metal to be welded. (Figure 4)

FIGURE 4

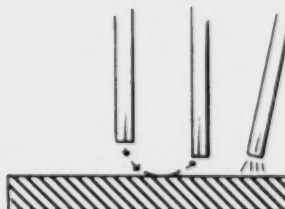


- Connect the electrode cable (+).
- Using personal protection
 - Use personal protection equipment as required by OSHA. Welding hood, leather gloves, and protective clothing are required.
 - You must also have an approved fire extinguisher adjacent to your work area.
 - Wear protective clothing.
- Selecting an electrode (welding rod)
 - The electrode type depends on the type and thickness of the base metal, welding position, the joint type to be welded, and job conditions. Use electrode manufacturer's guidelines to assist you in determining the electrode type and size.

- Setting the welding machine's amperage dial
 - The amperage dial is adjusted based on the type of base metal, its thickness, electrode type, and the job conditions. Use the welding machine's operating manual and trial welds to determine the optimal amperage setting.
 - Raising the amperage output produces more heat and increases penetration.
- Striking a test bead
 - Insert the electrode into the electrode holder.
 - Set up the base metal to be welded.
 - Switch on the AC power switch for the welding machine.
 - Ensure there are no bystanders or coworkers near the welding site and then position your own eye protection (goggles or helmet).
 - Strike a bead using the scratching method (Figure 5) or the tapping method. (Figure 6)
- A. Scratching method

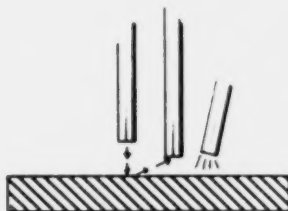
NOTE: The scratching method is similar to striking a match.

FIGURE 5



B. Tapping method

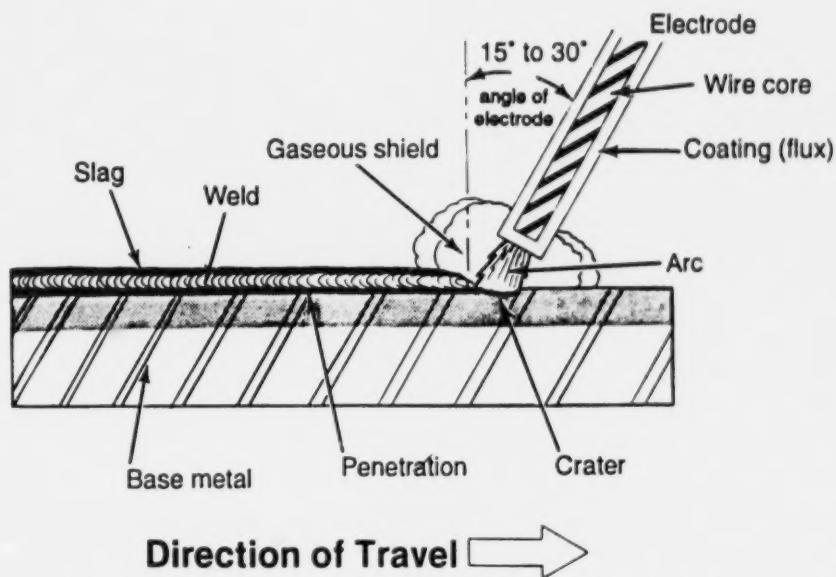
FIGURE 6



- Place the electrode at a 15 to 30° angle. (Figure 7)
- Keep the tip of the electrode at the same distance from base metal as the diameter of the electrode. (Figure 7)

EXAMPLE: When using a $\frac{1}{8}$ " electrode, the arc length should be $\frac{1}{8}$ ".

FIGURE 7

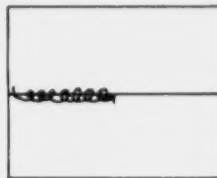


- With the proper arc length, you should hear a steady hum at the welding machine and a frying sound at the arc.
- Use one of several types of electrode motions. (Figures 8-10)

NOTE: On a single-layer weld, to ensure proper fusion in the root zone, the arc may progress with a straight forward motion or an oscillating motion, depending on size of joint to be filled.

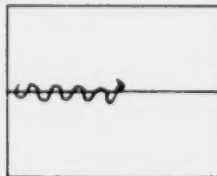
A. Small circular motion (Figure 8)

FIGURE 8



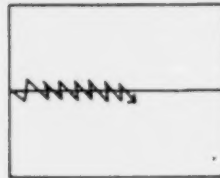
B. Oscillating motion (Figure 9)

FIGURE 9



C. Triangular motion (Figure 10)

FIGURE 10



D. Figure-eight motion

E. Back-and-forth motion with half circle

NOTE: Most welders use all of these motions, depending upon type of seam, type of joint, size of weld, and position of weld.

— Positions used in arc welding (Figures 11-14)

A. Flat

B. Horizontal

FIGURE 11

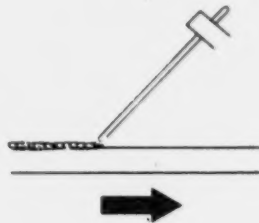
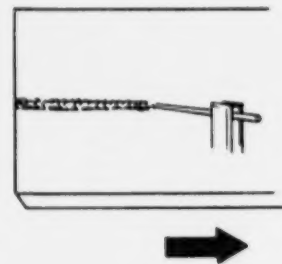
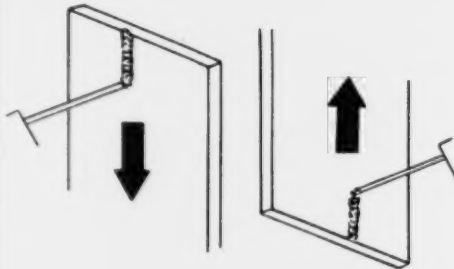


FIGURE 12



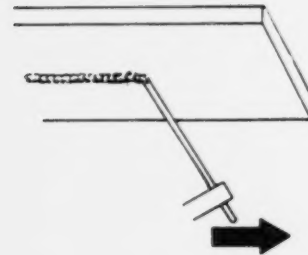
C. Vertical

FIGURE 13



D. Overhead

FIGURE 14



NOTE: In a vertical position, the bead may be started either from the top or bottom, depending on the characteristics of metal, plans, and specifications.

- Examining the test bead
 - Turn off the welding machine.
 - Examine the test bead and adjust the amperage dial, if necessary.
- Continue to weld
 - Power on the welding machine to continue welding.
- Inspecting and cleaning the bead
 - Turn off the welding machine.
 - Inspect the bead to ensure a good weld.
 - Clean the bead by removing the slag with a chipping hammer and a wire brush.



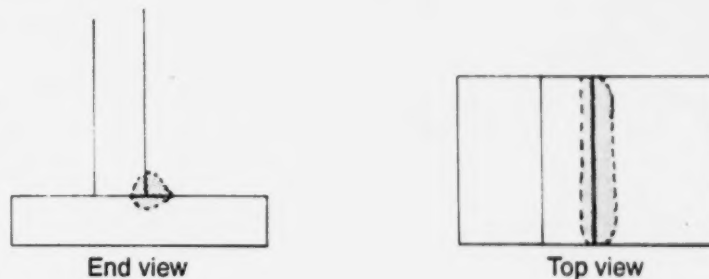
OBJECTIVE 4

Given drawings, label them with the proper weld and joint types. (Assignment Sheet 1)

- Weld types

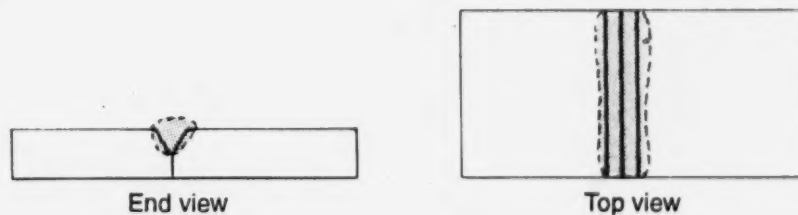
- Fillet weld — weld made in a corner or angle formed by two pieces of metal with welded surfaces at approximately 90-degree angles to each other (Figure 15)

FIGURE 15



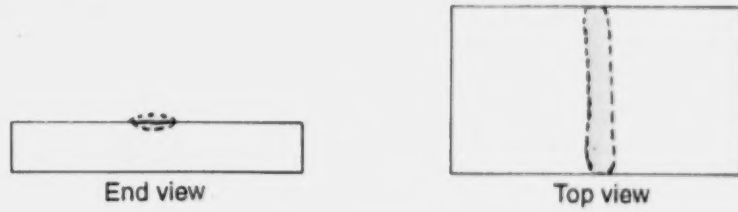
- Groove weld — weld made in a groove formed by two beveled pieces of metal (Figure 16)

FIGURE 16



- Bead weld — weld made by one pass of the electrode (Figure 17)

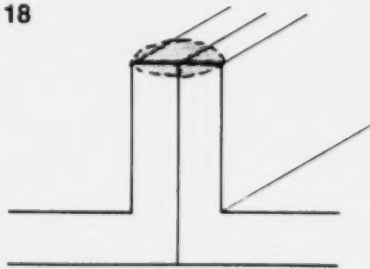
FIGURE 17



- Joint types

- Edge

FIGURE 18



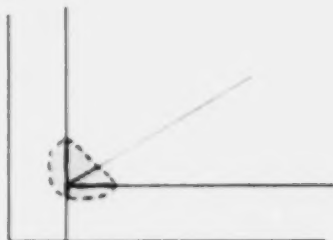
- Butt

FIGURE 19



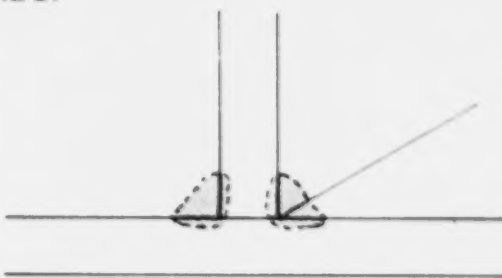
— Corner

FIGURE 20



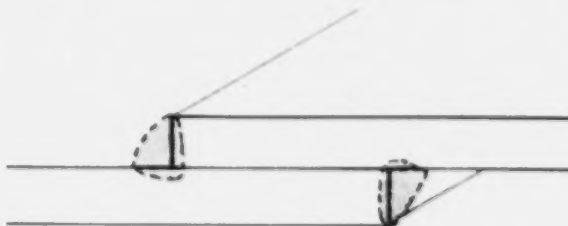
— "T"

FIGURE 21



— Lap

FIGURE 22



OBJECTIVE 5

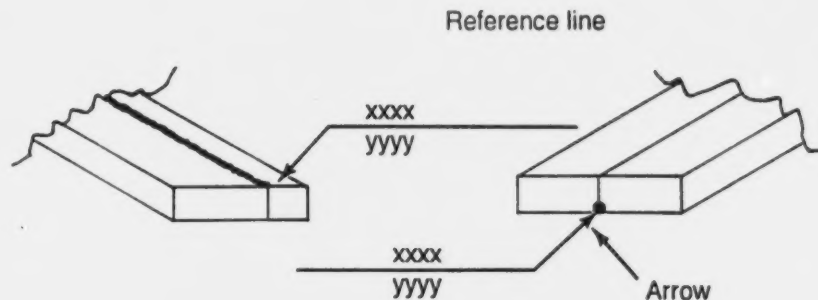
Given drawings, identify welding symbols. (Assignment Sheet 2)

- Basic welding symbols

NOTE: Welding symbols were developed as a method to document welding processes and specifications on drawings. They were developed by the American Welding Society to ensure standardization.

— Reference line and arrow (Figure 23)

FIGURE 23

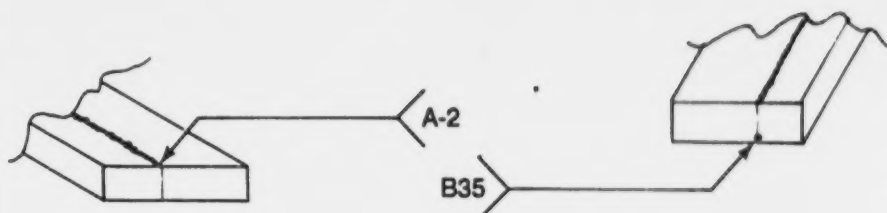


The reference line provides space to include information on a drawing about the weld (XXXX and YYYY). Weld information printed below the reference line (YYYY in Figure 23) corresponds to the weld pointed at by the arrow. The information on top of the line is related to the side of the joint opposite the arrow.



— Reference line tail

FIGURE 24

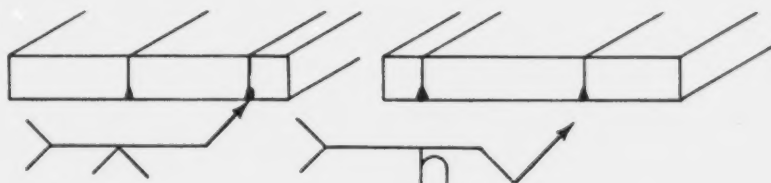


The tail includes specifications, processes, or other pertinent information (A-2 and B 35)

— Location of welds

A. Weld on only one side of joint

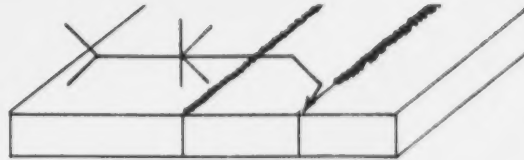
FIGURE 25



When there are multiple welds, a weld symbol is used to indicate the position of each. Each of the weld symbols indicate the types of weld required. These symbols will be described later in this objective.

B. Weld on both sides of joint

FIGURE 26



NOTE: Notice that when both sides of the joint are welded, the location and weld type is placed on top and below the reference line. (Figure 26)

— Weld and joint symbols

TABLE 1

— Contour symbols

Groove							
Square	Scarf*	V	Bevel	U	J	Flared V	Flared Bevel

Fillet	Plug or Slot	Spot or Projection	Seam	Back or Backing	Surfacing	Flange	
						Edge	Corner

* Used for brazed joints only

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— Supplementary symbols

TABLE 2

Weld All Around	Field Weld	Melt-Through	Backing or Spacer Material	Contour		
				Flush	Convex	Concave

Supplementary symbols may be used on drawings to indicate contour, backing or spacer material, melt-through, field weld, or to weld all around.

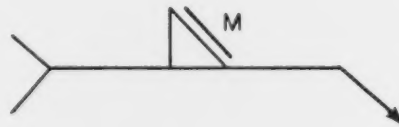
— Finish symbols

NOTE: Finishing of welds, other than cleaning, is indicated by appropriate contour and finish symbols. These symbols indicate the method, not the degree, of finish.

A. M — Machined

EXAMPLE:

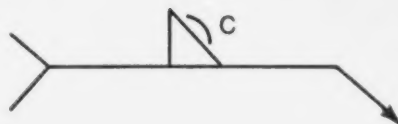
FIGURE 27



B. C — Chipped

EXAMPLE:

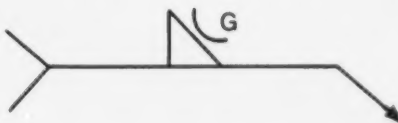
FIGURE 28



C. G — Ground

EXAMPLE:

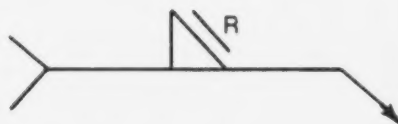
FIGURE 29



D. R — Rolled

EXAMPLE:

FIGURE 30



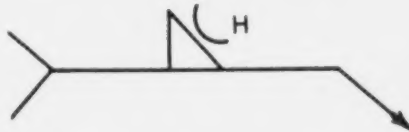
141



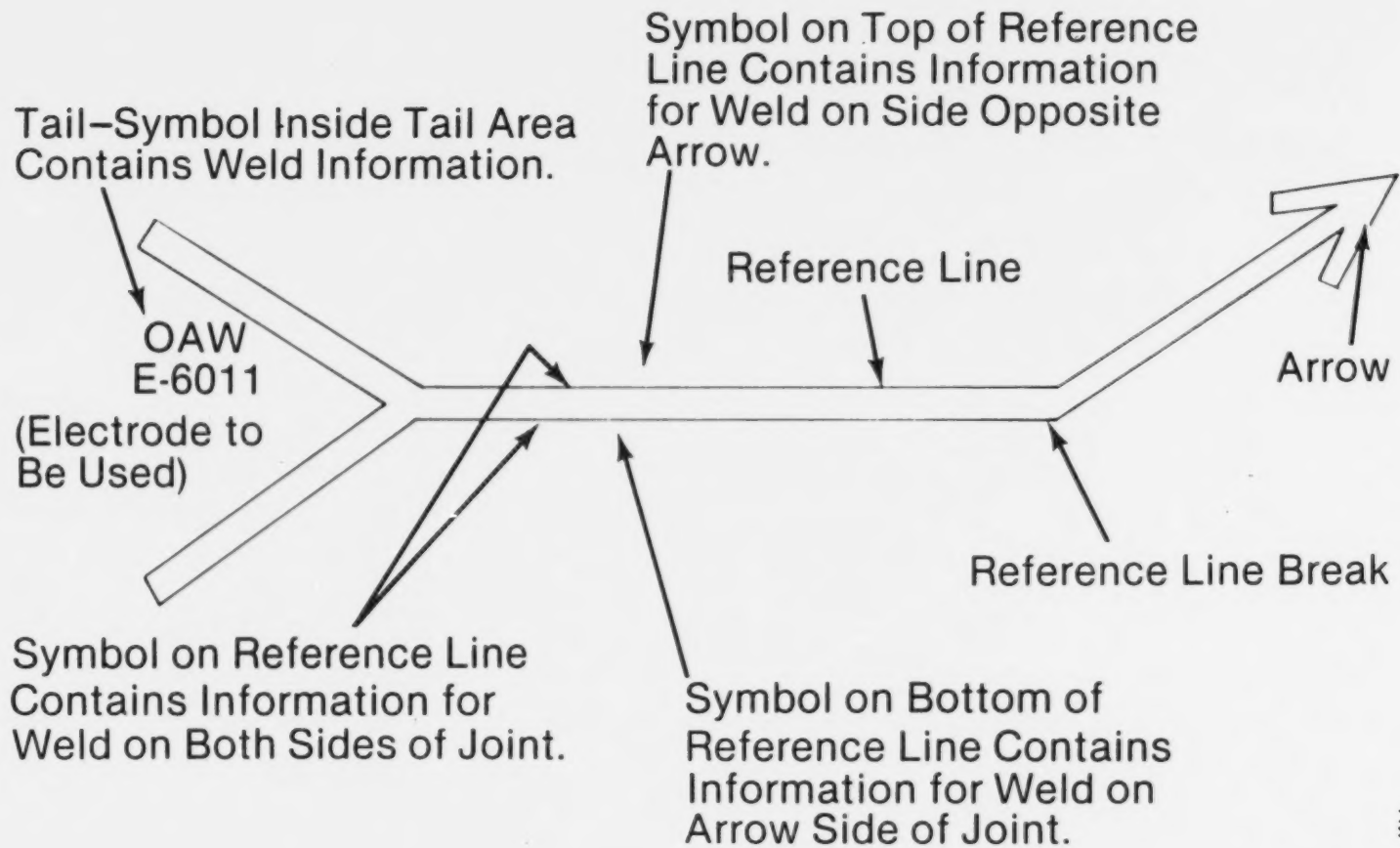
E. H — Hammered

EXAMPLE:

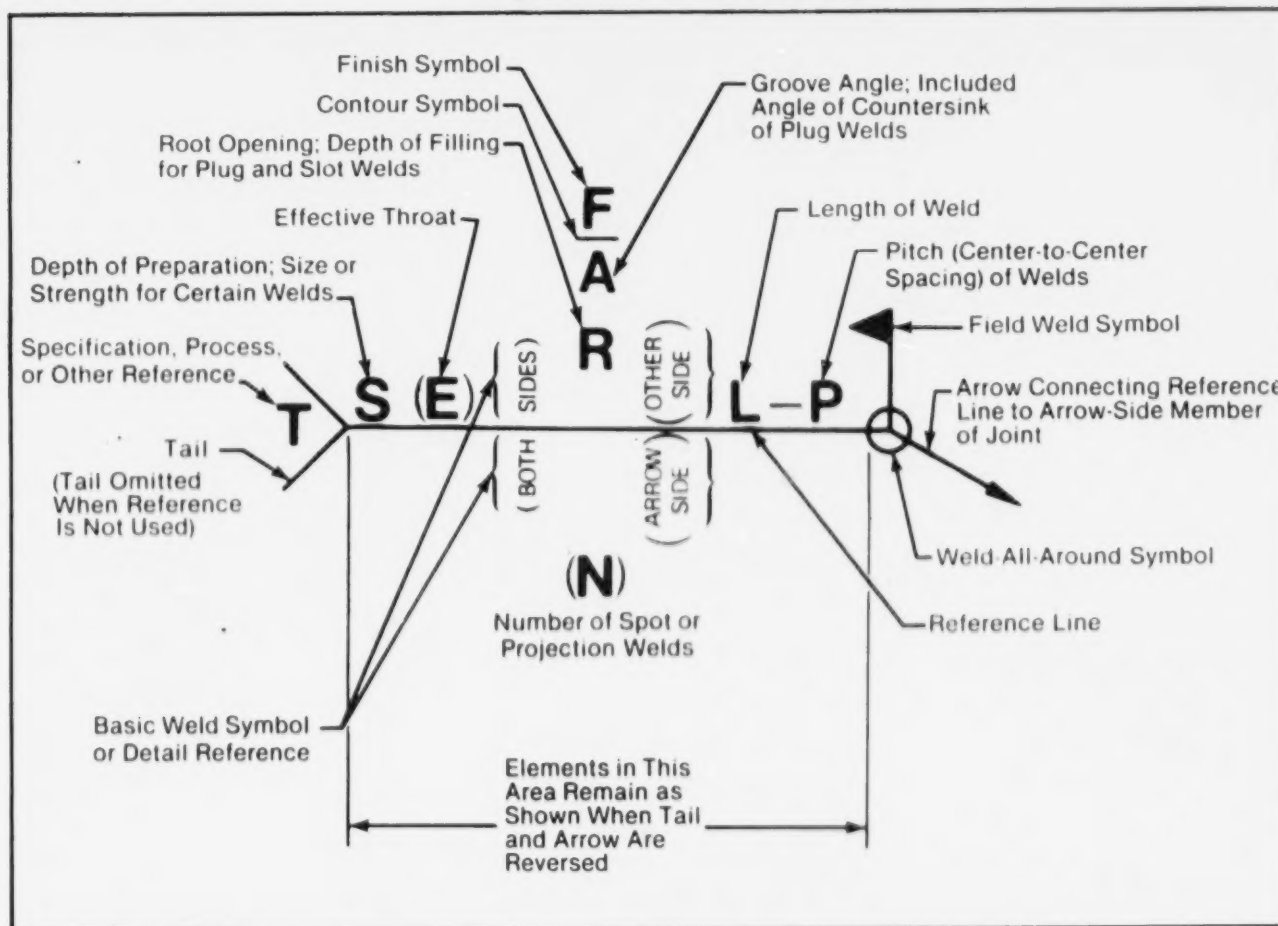
FIGURE 31



Elements of Welding Symbols



Standard Location of Welding Symbol Elements



TM 2

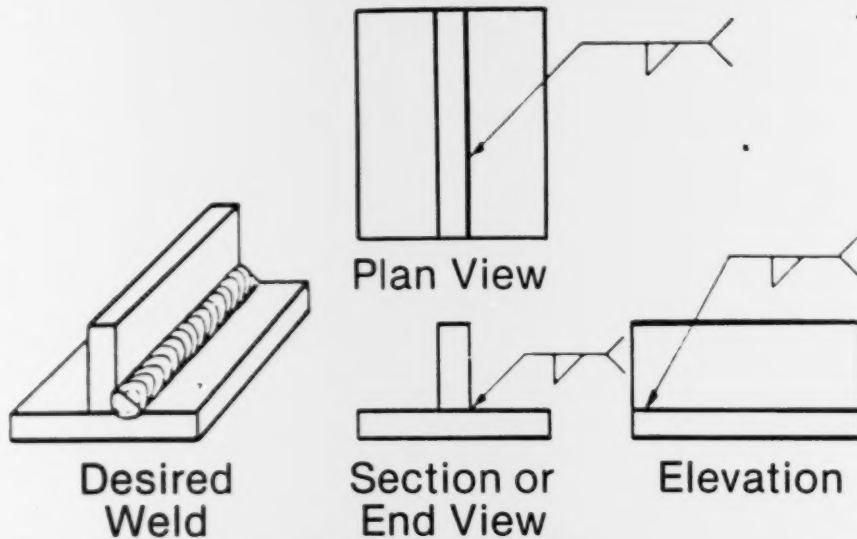
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CWC - A 3 - 31

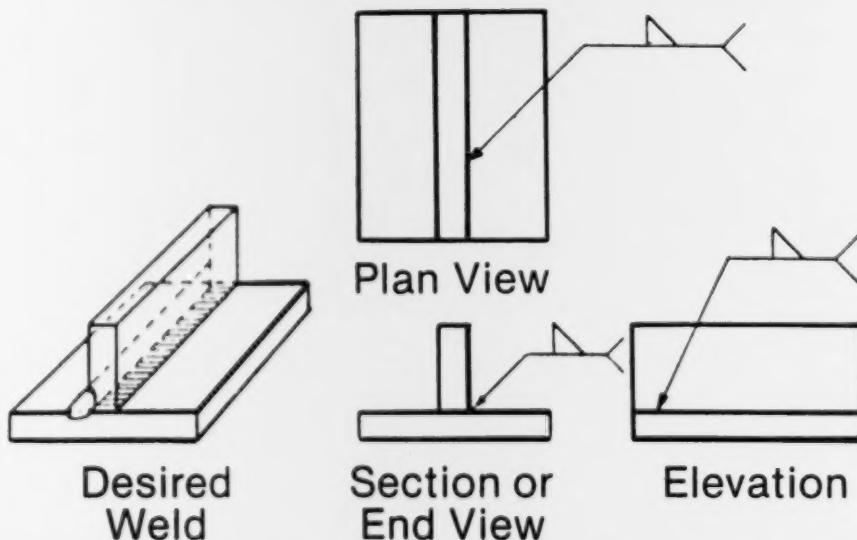


Application of Fillet Welding Symbol

Arrow Side of Fillet Welding Symbol

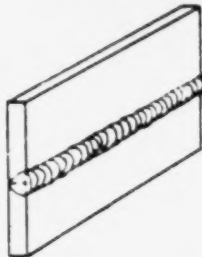


Other Side of Fillet Welding Symbol

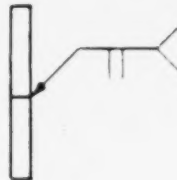


Application of Square-Groove Welding Symbol

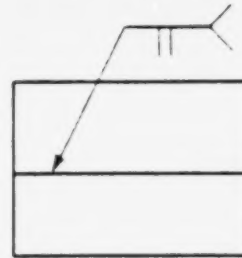
Arrow Side of Square-Groove Welding Symbol



Desired
Weld

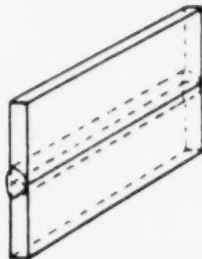


Section or
End View

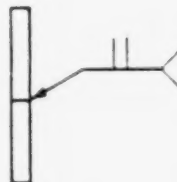


Elevation

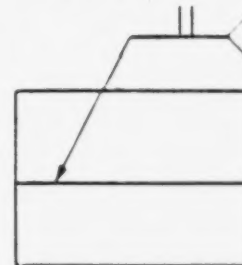
Other Side of Square-Groove Welding Symbol



Desired
Weld

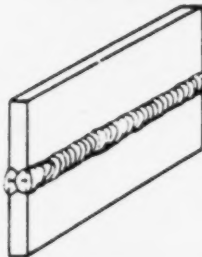


Section or
End View

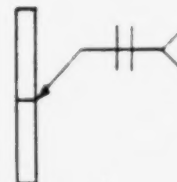


Elevation

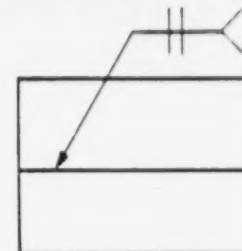
Both Sides of Square-Groove Welding Symbol



Desired
Weld



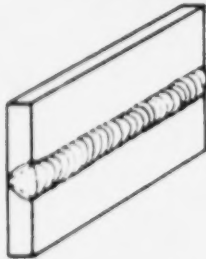
Section or
End View



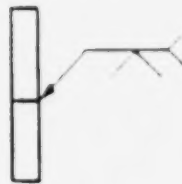
Elevation

Application of V-Groove Welding Symbol

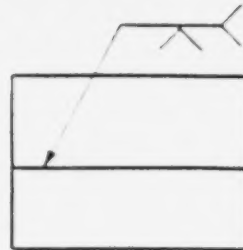
Arrow Side of V-Groove Welding Symbol



Desired
Weld

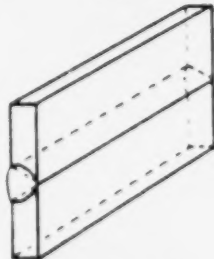


Section or
End View

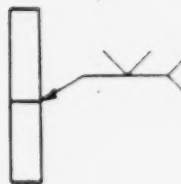


Elevation

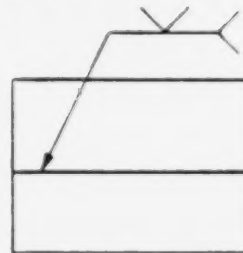
Other Side of V-Groove Welding Symbol



Desired
Weld

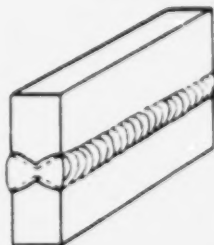


Section or
End View

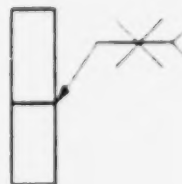


Elevation

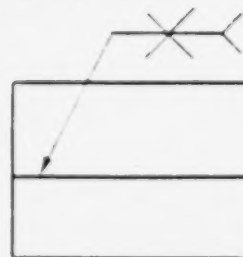
Both Sides of V-Groove Welding Symbol



Desired
Weld



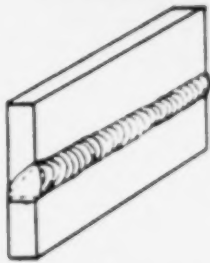
Section or
End View



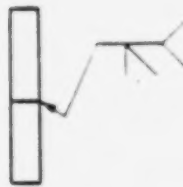
Elevation

Application of Bevel-Groove Welding Symbol

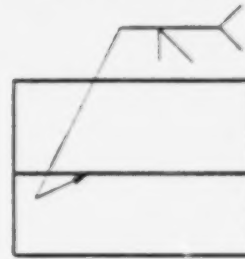
Arrow Side of Bevel-Groove Welding Symbol



Desired
Weld

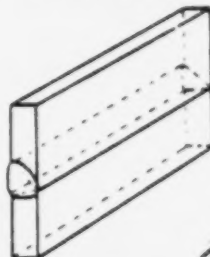


Section or
End View

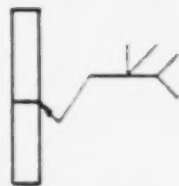


Elevation

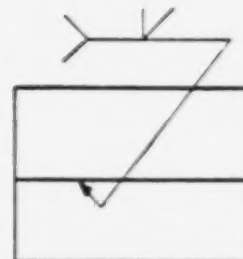
Other Side of Bevel-Groove Welding Symbol



Desired
Weld

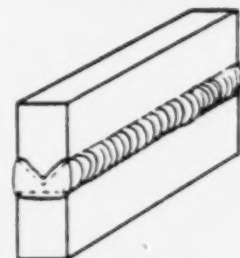


Section or
End View

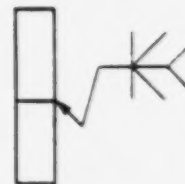


Elevation

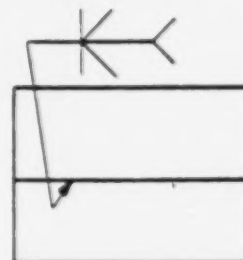
Both Sides of Bevel-Groove Welding Symbol



Desired
Weld



Section or
End View



Elevation



**ASSIGNMENT
SHEET 1**

APPLIED SKILLS

A 3

Name _____ Score _____

OBJECTIVE 4

Given drawings, label them with the proper weld types.

INTRODUCTION

The assignment will allow you to practice recognizing weld types.

INSTRUCTIONS

Match the weld type to each drawing.

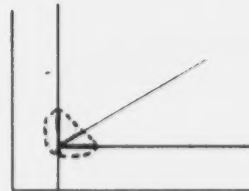


Functional Reading

- Use content area vocabulary

**Corner weld
Lap weld
Edge weld**

**"T" weld
Butt weld**

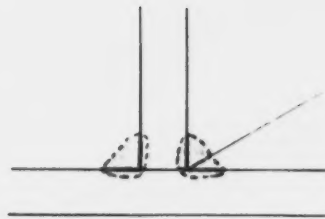


1. _____

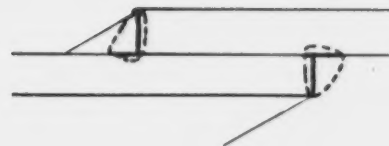
2. _____

151

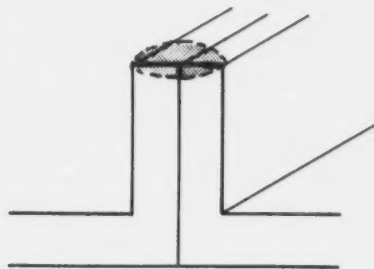




3. _____



4. _____



5. _____



ASSIGNMENT SHEET 2	APPLIED SKILLS	A 3
-------------------------------	-----------------------	------------

Name _____ Score _____

OBJECTIVE 5

Given drawings, identify welding symbols.

INTRODUCTION

Welders must be able to interpret drawings to gain information and specifications concerning construction projects. This exercise will provide you the needed practice to identify these symbols.

INSTRUCTIONS

Identify basic weld symbols. Write the correct names in the blanks.

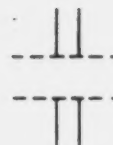
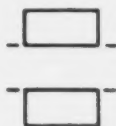


Functional Reading
• Use content area vocabulary

PART A — Welds and Joints

Edge flange
Corner flange
Surfacing
J-groove
Square groove
Scarf groove
V-groove
Fillet

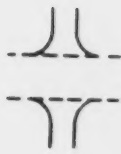
Flared V-groove
Flared bevel groove
U-groove
Bevel groove
Plug or slot
Spot or projection
Seam
Back or backing



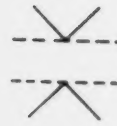
1. _____

2. _____

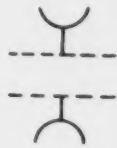




3. _____



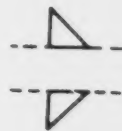
4. _____



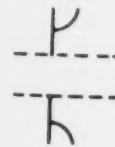
5. _____



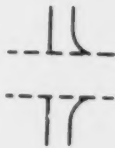
6. _____



7. _____



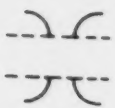
8. _____



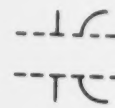
9. _____



10. _____

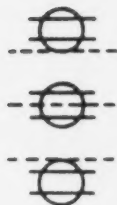


11. _____

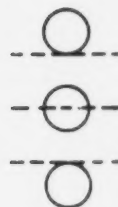


12. _____





13. _____



14. _____



15. _____



16. _____

PART B — Supplementary symbols

Backing or spacer material
Convex contour
Melt-through
Concave contour

Flush contour
Field weld
Weld all around

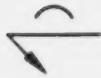


1. _____



2. _____

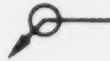




3. _____



4. _____



5. _____



6. _____

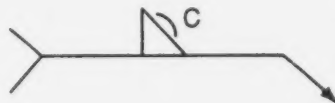


7. _____

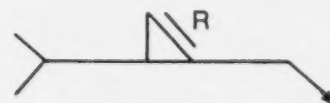
PART C — Finishes

Hammered
Rolled
Machined

Clipped
Ground

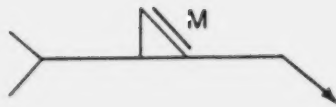


1. _____

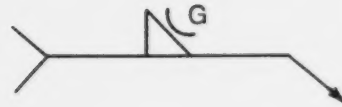


2. _____

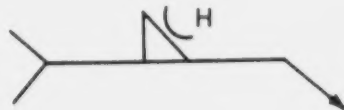




3. _____



4. _____



5. _____



ASSIGNMENT ANSWERS	APPLIED SKILLS	A 3
-------------------------------	-----------------------	------------

**ASSIGNMENT
SHEET 1**

1. Butt weld
2. Corner weld
3. "T" weld
4. Lap weld
5. Edge weld

**ASSIGNMENT
SHEET 2**

PART A

- | | |
|------------------|-------------------------|
| 1. Plug or slot | 9. Corner flange |
| 2. Square groove | 10. Scarf groove |
| 3. Edge flange | 11. Flared V-groove |
| 4. V-groove | 12. Flared bevel groove |
| 5. U-groove | 13. Seam |
| 6. Surfacing | 14. Spot or projection |
| 7. Fillet | 15. Bevel groove |
| 8. J-groove | 16. Back or backing |

PART B

- | | |
|-------------------------------|--------------------|
| 1. Melt-through | 5. Weld all around |
| 2. Backing or spacer material | 6. Field weld |
| 3. Convex contour | 7. Flush contour |
| 4. Concave contour | |

PART C

1. Chipped
2. Rolled
3. Machined
4. Ground
5. Hammered

OBJECTIVE 6
Prepare an oxyacetylene torch for cutting metal.
INTRODUCTION

This exercise will provide you practice in setting up an oxyacetylene torch in a safe and effective way.

**TOOLS AND
EQUIPMENT**

- Personal protection equipment to include hard hat, leather gloves, burning goggles and protective clothing
- Oxygen cylinder
- Acetylene cylinder
- Oxygen regulator
- Acetylene regulator
- Hoses
- Wrench
- Cylinder truck
- Foam or multipurpose dry-chemical fire extinguisher
- Soapsuds

NOTE: Liquid soap is recommended for making soapsuds.

- Clean paintbrush
- Torch body with tips
- Tip cleaner
- Flint lighter

PROCEDURE


- Functional Reading
- Follow written instructions

Yes No

1. Put on personal protection equipment. Be certain a fire extinguisher is adjacent to work area. ___ ___
2. Fasten cylinders in a vertical position on cylinder truck. ___ ___



CAUTION: To prevent damage to valves, never use acetylene from a cylinder that is not in a vertical position. Valve damage might cause cylinder to explode.





Job Acquisition/
Development

- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

3. Remove caps from cylinders. ___ ___
4. Open valves slightly on each cylinder to remove foreign material; close valves. ___ ___
5. Connect oxygen regulator to oxygen cylinder.



CAUTION: Do not use oil or thread compound on any connections in the oxyacetylene system.

- a. Turn oxygen pressure-regulating screw counterclockwise until tension on spring is released. ___ ___
 - b. Turn cylinder valve wide open slowly. ___ ___
6. Connect acetylene regulator to acetylene cylinder.
 - a. Turn acetylene pressure-regulating screw counterclockwise until tension on spring is released. ___ ___
 - b. Open cylinder valve one-half to three-quarters of a turn. ___ ___

NOTE: Never open cylinder valve more than one and one-half turns. Leave wrench with cylinder.

7. Connect acetylene hose to acetylene regulator; purge hose. Do so by opening the valve to allow air to escape. ___ ___



- | | Yes | No |
|---|-----|-----|
| 8. Connect oxygen hose to oxygen regulator; purge hose. | ___ | ___ |
| 9. Connect torch body to oxygen and acetylene hoses. | ___ | ___ |
| 10. Close both valves on torch body. | ___ | ___ |
| 11. Attach cutting attachment to torch body. | ___ | ___ |
| <p>NOTE: The tip size is determined by the thickness of metal to be cut and the manufacturer's instructions.</p> | | |
| 12. Close oxygen preheat valve on cutting attachment. | ___ | ___ |
| 13. Turn oxygen pressure-regulating screw clockwise until working pressure is reached. | ___ | ___ |
| 14. Turn acetylene pressure-regulating screw clockwise until correct working pressure is reached. | ___ | ___ |



CAUTION: At pressures higher than 15 psi, acetylene becomes unstable and highly explosive.

- | | | |
|---|-----|-----|
| 15. Use soapsuds to test all connections for leaks. | ___ | ___ |
|---|-----|-----|

NOTE: Apply soapsuds with a clean paintbrush.



	Yes	No
16. Assuming there are no leaks, you are ready to light the torch.	___	___
a. Open oxygen cylinder valve all the way.	___	___
b. Open oxygen torch valve all the way.	___	___
c. Open oxygen preheat valve on cutting attachment one turn.	___	___
d. Turn oxygen pressure-regulating screw clockwise until desired pressure is reached.	___	___
e. Close oxygen preheat valve on cutting attachment.	___	___
f. Open acetylene valve on torch one-quarter turn.	___	___
g. Clean tip.	___	___
NOTE: Clean tip before lighting torch and as often as needed.		
h. Light torch with flint lighter and adjust until smoke clears.	___	___
17. Open oxygen preheat valve slowly and adjust to a neutral flame.	___	___



- | | Yes | No |
|---|-----|----|
| 18. Depress oxygen cutting lever, and check to see that a neutral flame is present. | — | — |

NOTE: If necessary, adjust the oxygen preheat valve with the oxygen cutting lever depressed until a neutral flame is secured. Pressure rises slightly when the valve is closed.

- | | | |
|---|---|---|
| 19. Ask your instructor to evaluate your adjustments to obtain a neutral flame. | — | — |
|---|---|---|

20. Shut-off procedure

- | | | |
|------------------------------------|---|---|
| a. Close acetylene valve on torch. | — | — |
| b. Close acetylene cylinder valve. | — | — |
| c. Close oxygen preheat valve. | — | — |
| d. Close oxygen cylinder valve. | — | — |
| e. Open acetylene valve on torch. | — | — |

NOTE: When gages reach zero, close torch valve and turn acetylene pressure-regulating screw counterclockwise to release.



Yes No

- f. Open oxygen preheat valve on torch.

___ ___

NOTE: When gages reach zero, close oxygen preheat valve and turn oxygen pressure-regulating screw counterclockwise.

- g. Close oxygen valve on torch.

___ ___

21. Place torch and hose on hanger or brackets provided.

___ ___

NOTE: If regulators are removed from cylinders, replace the caps.

22. Clean work area; clean and put away all tools and equipment.

___ ___

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S
COMMENTS

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**PRODUCT
EVALUATION**

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Proper use of personal protection equipment	4	3	2	1
All setup procedures properly performed	4	3	2	1
Neutral flame proper	4	3	2	1
Shut-off steps properly followed	4	3	2	1

**EVALUATOR'S
COMMENTS**

**AVERAGE
RATING**

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

**PERFORMANCE
EVALUATION KEY**

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 **Unskilled** — Is familiar with process, but is unable to perform job



OBJECTIVE 7

Use an oxyacetylene torch to cut mild steel.

INTRODUCTION

This procedure will allow you to practice cutting metal with an oxyacetylene torch.

**TOOLS AND
EQUIPMENT**

- Personal protection equipment to include hard hat, burning goggles, leather gloves, and protective clothing
- Oxyacetylene cutting outfit with tip assembly
- Mild steel plate, approximately $\frac{1}{4}$ " $\times$ 4" $\times$ 8"
- Soapstone with a sharp point or edge
- Straightedge
- Pliers
- Flint lighter
- Welding or cutting table
- Slag box
- Can of water (large enough to hold the plate)
- Cutting tip
- Foam or multipurpose dry-chemical fire extinguisher
- Tip cleaners

PROCEDURE


Functional Reading
• Follow written instructions

- | | Yes | No |
|---|-----|----|
| 1. Put on your personal protection equipment. Place a fire extinguisher adjacent to your work area. | — | — |
| 2. Set up oxyacetylene outfit as described in Job Sheet 1. | — | — |
| 3. Prepare to make a 90-degree cut. | | |
| a. Mark three parallel lines 2 inches apart on plate to be cut. (Figure 32) | — | — |





Job Acquisition/
Development

- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

- b. Adjust oxygen regulator. _____
- c. Adjust acetylene regulator. _____
- d. Place plate to be cut over slag box. _____

4. Clean tip. _____

NOTE: Clean tip before lighting torch and as often as needed.

5. Light torch with flint lighter. _____

6. Adjust to neutral flame. _____

7. Place hoses behind you. _____

8. Assume a comfortable position. _____

9. Maneuver torch as required. _____

NOTE: Sometimes you must use both hands to hold the torch steady for a straight cut.

10. Hold preheat flame with tip of inner cone $\frac{1}{16}$ to $\frac{1}{8}$ inch above top of plate at right edge until red spot appears. _____



CAUTION: Burning metal flames, and sometimes sparks can cause burns.

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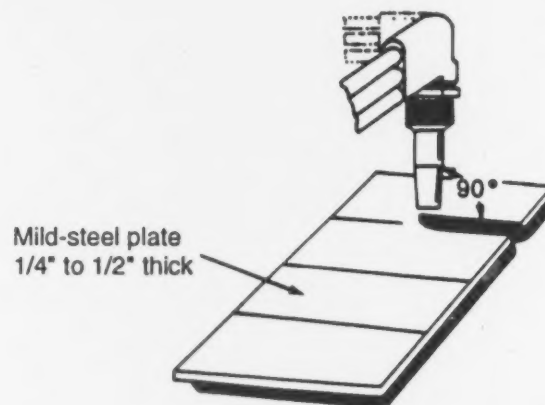
Yes No

11. Depress oxygen cutting lever and move from right to left across the plate. (Figure 32)

___ ___

NOTE: Left-handed operators move from left to right.

FIGURE 32



12. Hold tip at right angle to work, while cutting with inner cone approximately $\frac{1}{16}$ inch above work.
13. Make 90-degree cuts until you have developed the proper procedure.
14. Pick up metal with pliers.
15. Cool metal by placing in can of water.

___ ___

___ ___

___ ___

___ ___



EVALUATOR'S
COMMENTS

- | | Yes | No |
|---|-----|-----|
| 16. Remove metal from the water and allow to dry. | ___ | ___ |
| 17. Restart a cut. | | |
| a. Release oxygen cutting lever. | ___ | ___ |
| b. Preheat only the edge where cutting action was stopped. | ___ | ___ |
| c. Depress oxygen cutting lever slowly and continue cutting. | ___ | ___ |
| 18. Ask your instructor to evaluate your work. | ___ | ___ |
| 19. Shut off the oxyacetylene outfit using the procedures from Job Sheet 1. | ___ | ___ |
| 20. Clean work area; clean and put away all tools and equipment. | ___ | ___ |

(End of Job Sheet)

SKILL TEST RECORD

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**PRODUCT
EVALUATION**

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Proper use of personal protection equipment	4	3	2	1
All setup procedures properly followed	4	3	2	1
Metal cut to proper size ($\pm \frac{1}{8}$ ")	4	3	2	1
Metal cuts straight and with smooth edges	4	3	2	1
Shut-off steps properly followed	4	3	2	1

**EVALUATOR'S
COMMENTS**

**AVERAGE
RATING**

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

**PERFORMANCE
EVALUATION KEY**

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 **Unskilled** — Is familiar with process, but is unable to perform job



JOB SHEET 3	APPLIED SKILLS	A 3
------------------------	-----------------------	------------

OBJECTIVE 8

Use an electric arc welder to start, stop, and restart a bead.

INTRODUCTION

In this exercise, you will be using an electric arc welder to weld beads on a metal plate.

TOOLS AND EQUIPMENT

- Personal protection equipment to include a welding hood, leather gloves, and protective clothing
- Piece of metal, 4 inches square, 1/4- to 3/8-inch thick
- Welding machine
- Electrode holder with lead
- Ground clamp with lead
- Electrodes
- Wire brush
- Fire extinguisher

PROCEDURE

Yes No



Functional Reading

- Follow written instructions



Job Acquisition/ Development

- Master specific job task/procedure
- Practice good work habits/attitudes

1. Put on personal protection equipment and place a fire extinguisher adjacent to your work area.
2. Ask your instructor for an electrode (welding rod) that matches the size and type of metal to be welded.
3. Set up and adjust the amperage on the welding machine dial.
4. Prepare metal for welding.
5. Turn on the welding machine.
6. Position welding hood.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____



Yes No



CAUTION: Be certain there are no bystanders or coworkers in the work area. The intense light or flying metal can cause them severe eye injuries.

7. Strike arc 1 inch from edge where bead is to begin. (Figures 33 and 34) Use the tapping or scratching methods.

FIGURE 33

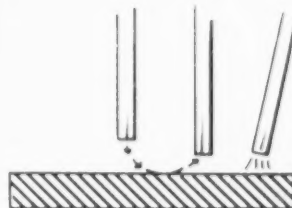
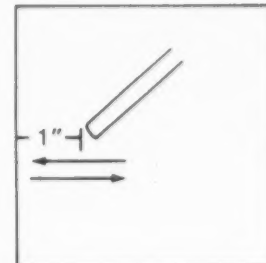


FIGURE 34



8. Move to edge when arc burns brightly, maintaining correct arc length; begin forming puddle.
9. Move across metal 2 inches.



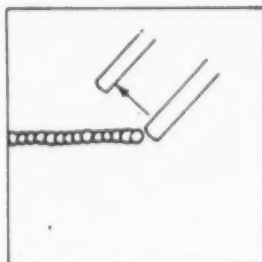
Yes No

10. Move electrode back through puddle, and lift up to stop bead. (Figure 35)

— —

NOTE: Moving electrode through puddle will prevent cracks from forming in the puddle.

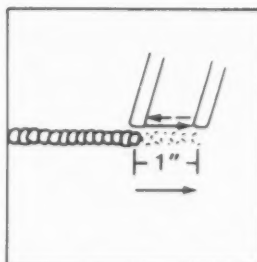
FIGURE 35



11. Strike arc about 1 inch in front of crater to restart. (Figure 36)

— —

FIGURE 36



Yes No

12. Move back through crater when arc burns brightly, and continue the bead.

___ ___

NOTE: Moving back through the crater is necessary in order for beads to blend with one another without a change in continuity.

13. Ask your instructor to evaluate your work.

___ ___

14. Shut off welding machine.

___ ___

15. Clean work area; put away all equipment and materials.

___ ___

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S
COMMENTS

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**PRODUCT
EVALUATION**

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Personal protection equipment used properly	4	3	2	1
All setup procedures performed properly	4	3	2	1
Bead uniform and blended	4	3	2	1

**EVALUATOR'S
COMMENTS**

**AVERAGE
RATING**

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

**PERFORMANCE
EVALUATION KEY**

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 **Unskilled** — Is familiar with process, but is unable to perform job

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OBJECTIVE 9

Use an electric arc welder to construct a pad weld.

INTRODUCTION

This procedure will allow you to practice using an electric arc welder to construct a pad weld.

**TOOLS AND
EQUIPMENT**

- Personal protection equipment to includes welding hood, leather gloves, and protective clothing
- Piece of metal, 4 inches square $\frac{1}{4}$ - to $\frac{3}{8}$ -inch thick
- Welding machine
- Electrode holder with lead
- Ground clamp with lead
- Electrodes
- Chipping hammer
- Wire brush
- Fire extinguisher

PROCEDURE

Yes No



Functional Reading

- Follow written instructions



Job Acquisition/
Development

- Master specific job task/procedure
- Practice good work habits/attitudes

1. Put on personal protection equipment and place a fire extinguisher adjacent to your work area. ____ ____
2. Ask your instructor for an electrode that matches the size and type of metal to be welded. ____ ____
3. Set up and adjust the amperage on the welding machine dial. ____ ____
4. Place metal on work bench. ____ ____
5. Turn on welding machine. ____ ____
6. Position welding hood. ____ ____

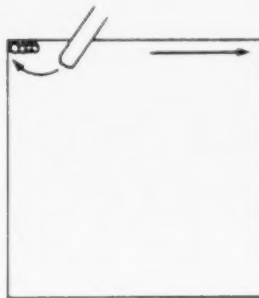


Yes No

7. Move to the point where weld begins.
(Figure 37)

— —

FIGURE 37



8. Lay a straight bead across the plate
using an oscillating motion.

— —

NOTE: When using an E-6011 electrode, you must manipulate the rod to run a bead. Ask your instructor to explain this process.

9. Hold electrode at a 15- to 30-degree
angle in the direction of travel; to
maintain correct arc length, lower
electrode as rod burns away.
(Figure 38)

— —

NOTE: There should be 90 degrees
on each side of the electrode.
(Figure 39)

FIGURE 38

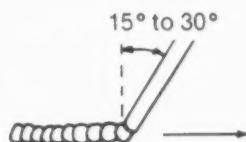
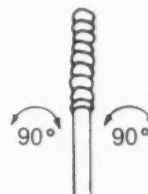


FIGURE 39



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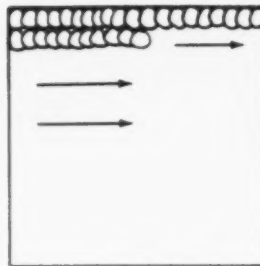
- | | Yes | No |
|--|-----|-----|
| 10. Move electrode steadily from left to right across pad. | ___ | ___ |
| 11. Clean slag from each bead before starting next one. | ___ | ___ |



CAUTION: If you remove your welding hood, always be sure to put on safety goggles.

- | | | |
|---|-----|-----|
| 12. Run beads, overlapping each bead until pad is full. (Figure 40) | ___ | ___ |
|---|-----|-----|

FIGURE 40



This

Not this

- | | | |
|---|-----|-----|
| 13. Let each bead cool, until slag is black, before chipping. | ___ | ___ |
| 14. Chip off slag. | ___ | ___ |
| 15. Run additional bead layers until desired thickness is obtained. | ___ | ___ |
| 16. Turn off welding machine. | ___ | ___ |



Yes No

17. Ask your instructor to evaluate your work.

18. Clean work area; put away all equipment and materials.

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S
COMMENTS

PRODUCT
EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Personal protection equipment used properly	4	3	2	1
Bead overlapped properly	4	3	2	1
Electrode held a proper angle (± 5 degrees)	4	3	2	1
Slag cleaned properly	4	3	2	1

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EVALUATOR'S
COMMENTS

AVERAGE
RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE
EVALUATION KEY

- 4 **Skilled** — Can perform job with no additional training
- 3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 **Unskilled** — Is familiar with process, but is unable to perform job



JOB SHEET 5	APPLIED SKILLS	A 3
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OBJECTIVE 10

Use an electric arc welder to construct a butt weld.

INTRODUCTION

Using a butt weld is a common practice in construction. It is important that you practice this procedure until you can construct a satisfactory metal bond.

TOOLS AND EQUIPMENT

- Personal protection equipment includes welding hood, leather gloves, and protective clothing.
- Two metal pieces 3 by 6 inches., 1/4- to 3/8-inch thick
- Welding machine
- Electrode holder with lead
- Ground clamp with lead
- Electrodes
- Chipping hammer
- Wire brush
- Fire extinguisher

PROCEDURE

Yes No



Functional Reading

- Follow written instructions



Job Acquisition/ Development

- Master specific job task/procedure
- Practice good work habits/attitudes

1. Put on personal protection equipment and place a fire extinguisher adjacent to your work area. ___ ___
2. Ask your instructor to provide an electrode that matches the size and types of metal to be welded. ___ ___
3. Set up and adjust the amperage on the welding machine dial. ___ ___

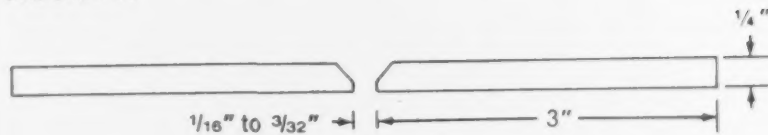


Yes No

4. Prepare metal to be welded. _____

NOTE: If metal thickness is over $\frac{1}{8}$ -inch, the edges should be beveled. See Figure 41.

FIGURE 41



5. Place two pieces of metal parallel to each other. _____

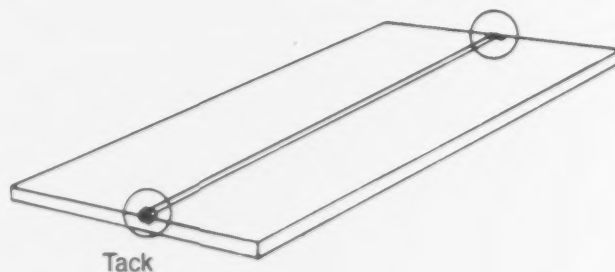
NOTE: Leave a space of $\frac{1}{16}$ - to $\frac{3}{32}$ -inch between them.

6. Turn on the welding machine. _____

7. Position welding hood. _____

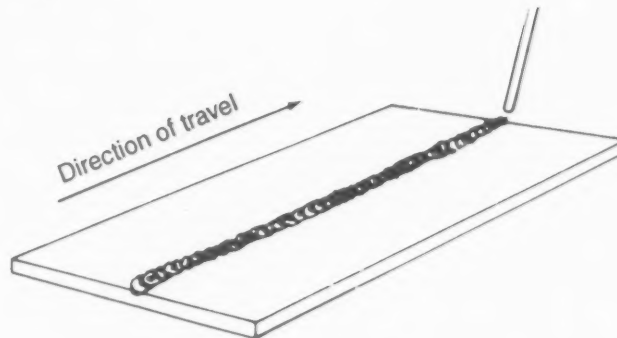
8. Strike an arc and tack-weld pieces together at both ends. (Figure 42) _____

FIGURE 42



- | | Yes | No |
|--|-----|-----|
| 9. Complete weld using a single pass.
(Figure 43) | ___ | ___ |

FIGURE 43



- | | | |
|--------------------------------|-----|-----|
| 10. Turn off welding machine. | ___ | ___ |
| 11. Chip slag; brush the weld. | ___ | ___ |



CAUTION: If you remove your welding hood, always be sure to put on safety goggles.

- | | | |
|--|-----|-----|
| 12. Ask your instructor to evaluate your work. | ___ | ___ |
| 13. Clean work area; put away all equipment and materials. | ___ | ___ |

(End of Job Sheet)



SKILL TEST RECORD

**EVALUATOR'S
COMMENTS**

**PRODUCT
EVALUATION**

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Personal protection
equipment used properly

4 3 2 1

Metal prepared properly with
bevel and spacing ($\pm 1/32"$)

4 3 2 1

Metal tacked at both ends

4 3 2 1

Bead smooth

4 3 2 1

Joint welded firmly and cleaned

4 3 2 1

**EVALUATOR'S
COMMENTS**

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**AVERAGE
RATING**

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

**PERFORMANCE
EVALUATION KEY**

- 4 Skilled** — Can perform job with no additional training
- 3 Moderately Skilled** — Has performed job during training program; limited additional training may be required
- 2 Limited Skill** — Has performed job during training program; additional training is required to develop skill
- 1 Unskilled** — Is familiar with process, but is unable to perform job



WRITTEN TEST	APPLIED SKILLS	A 3
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OBJECTIVE 1

Name _____ Score _____

Given a list of terms associated with welding skills, match them to their correct definitions. Write the letter that corresponds to the most correct answer.

- _____ 1. A weld made between two metal joints on the same plane is a
- a. fillet joint
 - b. butt joint
 - c. overlap joint
 - d. edge joint
- _____ 2. A material or substance that is harmful is called
- a. benignant
 - b. polarizing
 - c. catalyze
 - d. toxic
- _____ 3. An element that is normally a colorless, odorless, and tasteless gas used in combination with other substances in cutting and welding is
- a. propane
 - b. oxygen
 - c. toxic
 - d. hydrocarbon
- _____ 4. The metal center of an electrode is the
- a. wire core
 - b. flux
 - c. carbon center
 - d. hydrocarbon base

May be photocopied for student use.



- _____ 5. The portion of a weld that is molten at the place heat is applied is a
- a. slag
 - b. crater
 - c. penetration
 - d. puddle
- _____ 6. The metal that melts away during the oxyacetylene cutting process is
- a. puddle
 - b. waste
 - c. rippled metal
 - d. slag
- _____ 7. The coating on the outside of an electrode is
- a. flux
 - b. slag
 - c. wire core
 - d. flint covering
- _____ 8. An angular cut made on the vertical edge of the base metal to allow for better weld penetration is known as a/an
- a. butt joint
 - b. crater
 - c. bevel
 - d. overlap
- _____ 9. A single longitudinal progression of a welding operation along a joint or weld deposit is the
- a. crater
 - b. pass
 - c. bevel
 - d. overlap

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- _____ 10. Material that is lightly ruffled or covered with small waves is
- a. puddled
 - b. rippled
 - c. beveled
 - d. waffled
- _____ 11. When using an oxyacetylene torch, the flame disappears inside the torch body; at the same time, a squealing noise occurs. This occurrence is known as a
- a. flashback
 - b. backfire
 - c. flux flash
 - d. torch-up
- _____ 12. The depression at the termination of a weld is called the
- a. valley
 - b. void
 - c. crater
 - d. lapped end

OBJECTIVE 2

Select the proper phrase that completes statements that define the process of cutting metal with an oxyacetylene torch.

- _____ 1. The first procedure necessary to cut metal with an oxyacetylene torch is to
- a. observe all OSHA safety rules and regulations
 - b. set up the oxyacetylene torch
 - c. adjust the torch to a neutral flame
 - d. attach the torch tip
- _____ 2. You must ignite the torch with a
- a. match
 - b. propane lighter
 - c. flint lighter
 - d. any of the above

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- _____ 3. As a safety precaution, observe the torch tip for possible
- a. flares
 - b. flashbacks or backfires
 - c. pressure changes
 - d. flames
- _____ 4. Before making a cut in metal, you must first
- a. remove the slag
 - b. turn off the oxygen
 - c. preheat it
 - d. release the safety chain
- _____ 5. The torch valves must be adjusted to obtain
- a. a flashback
 - b. a neutral flame
 - c. a pressure flame
 - d. an orange flame
- _____ 6. If a flashback occurs, the FIRST valve you would close is the
- a. oxygen torch valve
 - b. acetylene torch valve
 - c. oxygen preheat valve
 - d. oxygen pressure-regulating screw
- _____ 7. Take precautions to prevent backfire caused by all of the following EXCEPT
- a. not enough acetylene or oxygen pressure for the tip size used
 - b. loose or dirty tip
 - c. overheating of the cutting tip
 - d. bad O-ring in the tip nut

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OBJECTIVE 3

Choose the proper word(s) that complete statements required to arc weld metals.

- _____ 1. When setting up an electric welder, you must attach the ground lead (-) from the welding machine terminal to the
- a. electrode
 - b. welding rod
 - c. metal to be welded
 - d. slag bed
- _____ 2. The required personal protection equipment required to weld includes
- a. welding goggles or welding helmet
 - b. leather gloves
 - c. protective clothing
 - d. all the above
- _____ 3. The selection of a welding rod depends most on the
- a. the size of the welding machine
 - b. the weather conditions
 - c. the type and thickness of the base material
 - d. the length of the leads
- _____ 4. You must be certain that an approved _____ is adjacent to your work area.
- a. fire extinguisher
 - b. electrode cabinet
 - c. power outlet
 - d. fire wall
- _____ 5. When using an electric arc welder, raising the amperage output produces _____ heat and _____ penetration.
- a. less, increases
 - b. more, increases
 - c. less, decreases
 - d. more, decreases

May be photocopied for student use.



- _____ 6. When using an electric arc welder, place the electrode at a _____ to _____ degree angle.
- a. 15, 45
 - b. 15, 35
 - c. 10, 30
 - d. 15, 30
- _____ 7. With the proper arc length, you should hear a steady hum at the _____ and a frying sound at the arc.
- a. electrodes
 - b. leads
 - c. welding machine
 - d. base metal
- _____ 8. Clean the bead by removing the _____ with a chipping hammer and a wire brush.
- a. tack points
 - b. slag
 - c. bonding metal
 - d. base metal
- _____ 9. When using a $\frac{3}{16}$ " electrode, the arc length should be
- a. $\frac{3}{16}$ "
 - b. $\frac{1}{8}$ "
 - c. $\frac{3}{8}$ "
 - d. $\frac{5}{16}$ "
- _____ 10. Types of electrode motions include small circles, oscillating, triangular, and
- a. back and forth in a line
 - b. straight line
 - c. figure eight
 - d. back and forth in a full circle

NOTE: Objectives 4-10 are evaluated on job sheets/assignment sheets in this unit. If you have not completed these components, see your instructor.

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WRITTEN TEST ANSWERS	APPLIED SKILLS A 3	
OBJECTIVE 1	1. b 2. d 3. b 4. a 5. d 6. d	7. a 8. c 9. b 10. b 11. a 12. c
OBJECTIVE 2	1. a 2. c 3. b 4. c	5. b 6. c 7. d
OBJECTIVE 3	1. c 2. d 3. c 4. a 5. b	6. d 7. c 8. b 9. a 10. c
OBJECTIVES 4-10	Evaluated through the completion of assignment and job sheets.	



TOTAL NUMBER OF BASIC SKILL QUESTIONS 4

[illegible]

INTRODUCTION TO CONSTRUCTION WELDING COMPETENCY PROFILE

Student _____ Soc. Sec. No. _____
 Last First MI

PROGRAM _____	Grade 9 10 11 12 Adult	SCHOOL _____
INSTRUCTOR _____	SCHOOL ADDRESS _____	PHONE _____
STUDENT'S HOME ADDRESS _____	DATE OF BIRTH _____	PHONE _____
STUDENT'S EMPLOYER _____	ADDRESS _____	PHONE _____
CONTACT IN CASE OF EMERGENCY _____		PHONE _____
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ON-THE-JOB TRAINING/WORK EXPERIENCE

DURATION OF EMPLOYMENT	JOB TITLE	EMPLOYER	SUPERVISOR'S NAME	ADDRESS OF EMPLOYER	PHONE

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SPECIFIC JOB COMPETENCIES

DIRECTIONS: Evaluate the trainee using the rating scale below, and check the appropriate number to indicate the degree of competency. The numerical ratings of 4, 3, 2, 1, and 0 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on level of student performance for each of the tasks listed below.

Rating Scale:

- 4 — **Skilled** — can perform job independently with no additional training
- 3 — **Moderately Skilled** — has performed job independently during the training program; limited additional training may be required
- 2 — **Limited Practice** — has practiced job during training program; additional training is required to develop skill
- 1 — **Exposure Only** — general information provided with no practice time; close supervision needed and additional training required
- 0 — **No Exposure** — no information or practice provided during training program; complete training required

UNIT A1

4	3	2	1	0

Welding Material

1. Given a list of terms associated with welding materials, match them to their correct definitions.
2. With a definition given, pick the correct metal bonding method.
3. Choose metal types according to their characteristics.
4. Select the word or phrase that correctly completes statements concerning preheating and postheating of metals.
5. Match temperature-sensing devices to their correct applications.
6. Provided a list of common electrode sizes and types, select those used in arc welding.
7. Identify standard metal shapes.
8. _____

WRITTEN TEST SCORE _____

UNIT A2

4	3	2	1	0

Welding Tools and Equipment

1. Given a list of terms and abbreviations associated with welding tools and equipment, match them to their correct definitions.
2. State the purpose of the major components of common equipment used in electrical arc and oxyacetylene welding.
3. From a list of alternatives, choose the proper safety guidelines for the use of welding tools and equipment.
4. Choose the word or phrase that correctly complete statements concerning the proper care of welding tools and equipment.
5. Identify welding tools and equipment by their drawings or designated uses.
6. _____

WRITTEN TEST SCORE _____

UNIT A3

4	3	2	1	0

Applied Skills

1. Given a list of terms associated with welding skills, match them to their correct definitions.
2. Select the proper phrase that completes statements that define the process of cutting metal with an oxyacetylene torch.
3. Choose the proper phrase that completes statements required to arc weld metals.
4. Given drawings, label them with the proper weld types.
5. Given drawings, identify welding symbols.
6. Prepare an oxyacetylene torch for cutting metal.
7. Use an oxyacetylene torch to cut mild steel.
8. Use an electric arc welder to start, stop, and restart a bead.
9. Use an electric arc welder to construct a pad weld.
10. Use an electric arc welder to construct a butt weld.
11. _____

WRITTEN TEST SCORE _____

Use of This Document

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CIMC



READING SKILLS



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WRITING SKILLS



MATH SKILLS

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Functional Math	General Science	Life Science	Physical Science	Earth Science
Interpret statistics				
Interpret blueprints/plans				
Make measurements				
Perform banking transactions				
Make change				
Solve practical problems				
Calculate gross earnings				
Solve income/expense problems				
Prepare a budget				
Calculate interest				
Solve interest problems				
Calculate sales tax				
Determine income tax				
Use calculator for computation				
Use computer for computation				
Use computer spreadsheets				
Apply computing skills				
Apply scientific method of inquiry				
Conduct experiments				
Investigate science ethics				
Investigate science history				
Investigate/apply economics in technology				
Use scientific instruments				
Investigate/apply technology				
Collect specimens				
Identify/classify living organisms				
Investigate biological history of the earth				
Investigate food chains, webs, pyramids				
Investigate/apply principles of human development				
Investigate/apply principles of genetics/heredity				
Investigate/apply principles of anatomy/physiology				
Investigate health issues				
Analyze/classify matter				
Investigate forms/changes of matter				
Investigate forms/changes of energy				
Investigate/apply chemical properties				
Investigate/apply physical laws				
Investigate physical characteristics of the earth				
Investigate geological history of the earth				
Investigate physical forces acting on the earth				
Solve problems of longitude, latitude, and time zones				
Investigate conservation of physical resources				
Investigate conservation of living resources				
Investigate issues of environmental impact				
Apply science principles to environmental issues				



ORAL COMMUNICATION SKILLS



INTERPERSONA SKI

Oral
Presentation

Listening

Interactive Communication

General
Relating

UNITS OF INSTRUCTION

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PERSONAL OR RELATING SKILLS



CREATIVE THINKING/ PROBLEM SOLVING SKILLS



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Teamwork/ Cooperation	Leadership/ Influence	Cognitive Activities	Job Search Selection
Participate in group activities Participate in industrial relations/functions Identify personal values/attitudes Apply information to life experiences Identify values/attitudes Identify needs/drives Select/apply appropriate behavior Investigate/identify personal styles Investigate/identify group/corporate climate Give/receive feedback Identify hidden purposes Investigate/apply group dynamics Control undesirable/inappropriate behavior Resolve conflicts Clarify goals/objectives Devise "win/win" situations Build consensus Generate ideas Present point of view Analyze/apply leadership styles Analyze/apply management styles Obtain confidence of others Develop esteem in self/others Persuade others Analyze/apply motivation techniques Provide positive coaching	Collect/record information Identify critical elements/issues Define a problem Identify underlying causes Apply a problem solving model Analyze/synthesize information Identify/analyze underlying assumptions Draw conclusions Predict results/outcomes Identify/evaluate consequences Identify/develop alternatives Evaluate alternatives Select an alternative Devise a solution Create a finished product Apply intuitive/creative thinking processes Transfer knowledge/training to new situations Apply new technology Develop an action plan Evaluate results/outcomes Analyze personal occupational aptitudes/preferences Investigate employment prospects of a career field/occupation Investigate training requirements for a career field/occupation Investigate benefits of a career field/occupation Compare/evaluate career options Develop personal career path Locate appropriate jobs Analyze duties/requirements/benefits of		

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